PUBLIC HEALTH REPORTS

VOL. 53 DECEMBER 23, 1938 NO. 51

PREVALENCE OF COMMUNICABLE DISEASES IN THE UNITED STATES

November 6–December 3, 1938

The accompanying table summarizes the prevalence of eight important communicable diseases, based on weekly telegraphic reports from State health departments. The reports from each State are published in the Public Health Reports under the section "Prevalence of Disease." The table gives the number of cases of these diseases for the 4-week period ending December 3, 1938, the number reported for the corresponding period in 1937, and the median number for the years 1933–37.

DISEASES ABOVE MEDIAN PREVALENCE

Influenza.—For the 4 weeks ending December 3 there were 4,905 cases of influenza reported, as compared with 4,495, 3,650, and 3,359 for the corresponding period in 1937, 1936, and 1935, respectively. Since the latter part of the summer the influenza incidence has been relatively high, but so far there has been no indication of an epidemic of this disease. For the country as a whole the incidence was about 30 percent above the preceding 5-year average. In the South Atlantic region an excess over the 1933–37 median of about 45 percent was reported; in the West South Central section the excess amounted to about 65 percent, while in the Mountain region the number of cases (543) was almost three times the average incidence in that region. In other regions the incidence either closely approximated the median figure for this period or fell considerably below it. An increase of this disease is expected at this time; and while some of the regions showed considerable increases over the 5-year average, the number of cases was not especially large in any region.

Smallpox.—The number of cases (494) of smallpox was only about 50 percent of the number reported for this period in 1937, but it was 20 percent above the average seasonal incidence. The incidence was relatively high in the North and South Central regions, but considerably below normal in the Mountain and Pacific regions; only one case was reported from the South Atlantic region and none from the North Atlantic regions.

107110°—38——1

Number of reported cases of 8 communicable diseases in the United States during the 4-week period November 6–December 3, 1938, the number for the corresponding period in 1937, and the median number of cases reported for the corresponding period 1933–37 [1]

Division	Diphtheria			Influenza [2]			Measles [2]			Meningococcus meningitis		
	Current period	1937	5-year median	Current period	1937	5-year median	Current period	1937	5-year median	Current period	1937	5-year median
United States [1]	3,570	3,676	5,162	4,905	4,495	3,721	10,095	15,867	10,567	135	279	279
New England	104	59	59	36	25	24	924	898	1,055	4	9	9
Middle Atlantic	323	352	409	79	104	94	1,710	6,264	2,141	26	39	39
East North Central	631	636	1,091	261	411	411	835	3,295	822	14	35	41
West North Central	313	306	484	146	168	192	2,290	1,901	1,084	7	21	21
South Atlantic	946	948	1,311	1,774	1,209	1,233	1,132	1,704	1,482	31	74	49
East South Central	435	409	659	468	699	466	198	627	627	31	57	27
West South Central	532	514	566	1,400	1,402	849	347	231	110	8	17	16
Mountain	123	238	106	543	278	194	930	637	556	8	7	8
Pacific	163	214	214	198	199	250	1,729	310	881	6	20	20

Division	Poliomyelitis			Scarlet fever			Smallpox			Typhoid and paratyphoid fever		
	Current period	1937	5-year median	Current period	1937	5-year median	Current period	1937	5-year median	Current period	1937	5-year median
United States [1]	90	312	332	14,007	17,052	17,714	494	910	408	775	947	1,245
New England	4	12	12	632	1,126	1,051	0	0	0	24	35	24
Middle Atlantic	25	35	46	2,247	2,837	3,286	0	0	0	93	136	149
East North Central	9	45	54	4,919	5,666	5,666	156	129	103	96	95	167
West North Central	8	49	40	1,807	2,776	2,246	176	334	129	78	65	94
South Atlantic	17	16	30	1,227	1,378	1,597	1	6	5	113	139	209
East South Central	11	31	31	849	696	758	15	62	9	76	77	184
West South Central	9	41	18	681	837	476	57	22	21	168	288	288
Mountain	2	15	15	471	815	815	55	191	84	78	70	75
Pacific	5	68	63	1,174	921	1,172	34	166	109	49	42	65

[1] 48 States. Nevada is excluded and the District of Columbia is counted as a State in these reports.
[2] 44 States and New York City.
[3] 46 States. Mississippi and Georgia are excluded.

DISEASES BELOW MEDIAN PREVALENCE

Meningococcus meningitis.—During the current period 135 cases of meningococcus meningitis were reported, approximately 50 percent of the number reported for the corresponding period in 1937. With the exception of the year 1934, when 129 cases occurred during this period, the current incidence is the lowest in the 10 years for which these data are available. The incidence of this disease has been low throughout the current year, and contrary to the usual trend of the disease, a decline from the preceding 4-week period was reported, rather than an increase, which is normally expected at this season.

Measles.—During the 4 weeks ending December 3, the number of cases of measles increased about 50 percent over the incidence during the preceding 4 weeks. An increase of measles is normally expected at this season of the year. However, the number of cases (10,097) was only about 65 percent of the number reported for the corresponding

period in 1937 and was slightly below the 1933–37 median. The disease was unusually prevalent in the West North Central and Pacific regions, with smaller increases over the average incidence occurring in the East North Central, West South Central, and Mountain regions; in the Atlantic coast regions the incidence was relatively low.

Poliomyelitis.—For the 4 weeks ending December 3 there were 90 cases of poliomyelitis reported, as compared with 312, 543, and 509 for the corresponding period in 1937, 1936, and 1935, respectively. In 1929 and 1932, the only other nonepidemic years in the past 10 years, the cases for this period totaled 202 and 177, respectively. Each section of the country shared in this favorable situation. In 1931, 1933, and 1935, when the disease was epidemic in States along the Atlantic coast, the cases for this period totaled 625, 268, and 509, respectively. In 1934 California and other Western States experienced a severe outbreak, while in 1936 and 1937 less severe outbreaks were reported from States in the South Central regions. In 1930 the disease attained epidemic-like proportions in the North Central and Western regions. There has been no epidemic in any part of the country during the current year, and it is probable that the disease will continue to decline to the lowest incidence on record.

Scarlet fever.—The scarlet fever situation was more favorable in most sections of the country than it has been in recent years. For the country as a whole the number of cases (14,007) reported for the 4 weeks ending December 3 was the lowest number reported for this period in the 10 years for which these data are available. The South Central regions reported a few more cases than normally occur at this season of the year and the Pacific region reported about the average number of cases; in all other regions the incidence was relatively low.

Typhoid fever.—The incidence of typhoid fever remained comparatively low. The number of cases reported for the current period was 775, as compared with 947 cases for the corresponding period in 1937, and with an average of 1,245 cases for the 5 preceding years. The year 1937 being a year of relatively low incidence of this disease, the 1933–37 average was somewhat reduced; the average for the years 1929–37 was approximately 1,400 cases, making the current incidence slightly more than one-half the 9-year average.

Diphtheria.—The diphtheria incidence remained very satisfactory. The current incidence (3,570 cases) was slightly lower than that during the corresponding period in 1937, and represented a decline of about 30 percent from the 1933–37 figure (5,162) for this period. Sixty-six cases reported from Maine seemed mostly responsible for a relatively high incidence in the New England region, and an excess in the Mountain region was largely due to the occurrence of 61 cases in Colorado; other regions reported a comparatively low incidence.

MORTALITY, ALL CAUSES

The average mortality rate from all causes in large cities for the 4 weeks ending December 3, based on data received from the Bureau of the Census, was 11.0 per 1,000 population (annual basis). The weekly rate of 12.1 for the last week of the period was almost 10 percent above the average rate for the corresponding week in the 5 preceding years, but the average rate for the current 4-week period was slightly below that for corresponding 4-week periods in recent years.

LONGEVITY OF THE TICK *Ornithodoros turicata* AND OF *Spirochaeta recurrentis* WITHIN THIS TICK[1]

By EDWARD FRANCIS, *Medical Director* (Retired), *United States Public Health Service*

Relapsing fever occurring in central Texas and transmitted to man by ticks of the species *Ornithodoros turicata* was reported by Weller and Graham in 1930 and by Graham in 1931. For the 5-year period 1930 to 1934, Kemp, Moursund, and Wright (1935) collected 258 cases in Texas, with no deaths. The U. S. Bureau of the Census reported one death from relapsing fever in Texas for each of the years 1935 and 1936. The California State Department of Public Health reported 100 cases in California for the period 1930 to 1935.

The present paper relates to laboratory observations extending over 7 years upon 119 naturally infected *O. turicata* ticks collected in caves in Texas in 1931 and upon the survival of relapsing fever spirochetes within those ticks throughout 6½ years. The answers to the questions of how long this tick will live and how long it will carry virulent spirochetes are held by 14 of the original ticks which still survive in good condition, all of which are females. The importance of these observations from the viewpoint of eradication of relapsing fever is apparent. Control measures must reckon with a tick hiding in caves and living in rodent burrows, harboring virulent spirochetes in its fasting body for 5 years and in its fed body for 6½ years (and probably longer) and transmitting the infection through the egg to the next generation of ticks.

HISTORY OF THE TICKS

I am indebted for the ticks to Dr. J. J. Reid, formerly Director of Laboratory of the Texas Live Stock Sanitary Commission, located at Fort Worth, Tex., who sent them to the late Dr. Mark Francis, Dean of the School of Veterinary Medicine of the Agricultural and Mechanical College of Texas who, in turn, sent them to me. One lot comprised 80 ticks which were collected in the E. E. Swindle cave, located

[1] From the National Institute of Health, Washington, D. C.

in the northwest corner of Mills County, Tex., and was sent under date of September 10, 1931. Another lot comprised 39 ticks which were collected in "blue bug" cave on the Yates ranch in the southeast corner of San Saba County, Tex., and was sent under date of September 24, 1931.

The ticks arrived at the National Institute of Health, Washington, D. C., in fine powder or sand taken from the floors of dry caves in which they have their habitat. On arrival the ticks were flat and did not show evidence of recent feeding. Attempt was not made to classify them into males, females, and nymphs, but their size indicated that none belonged to the early stages. After the first feeding of 99 ticks 52 skins were shed, but thereafter only an occasional skin was found. The age of the ticks on arrival and the method by which they became naturally infected are unknown. Since we did not know the percentage of infected ticks, tests for infectivity were made on groups of ticks instead of on individual ticks.

DRY CAVES FROM WHICH THE TICKS WERE COLLECTED

Some of the so-called caves could, with greater accuracy, be called overhanging ledges, because they are produced by water erosion of a river bank and have a horizontal depth of only a few feet to perhaps 20 feet. They have a ceiling of clay, sandstone, or limestone, which may be not over 4 feet in height. The floor is covered with dry, powdery dust or sand which may reach a depth of 5 inches. The entrance may admit man and animals freely. Other caves have a horizontal depth of from 50 to 500 feet, ceiling and walls of sandstone, and may be located several miles from a stream. Ticks located in the dust of the caves have an advantageous position for attachment to the legs of passing animals and of man. They may be separated from the dust by sifting through a screen.

A cave 12 miles west of Junction, Kimble County, Tex., from which *O. turicata* ticks were collected, was described by its owner as located a mile and a half from a river, at the top of a hill, above all high water marks. But during continued wet weather, the cave becomes wet from water seeping through cracks in the limestone ceiling, which is only 2 feet below the surface of the ground. Its walls and floor are of adobe or caliche. The entrance to the cave is about 3½ by 6 feet, its height 2 to 6 feet, and its horizontal depth 10 to 12 feet.

Chemical determinations of samples from caves.—A sample of dust from the floor of the above-described cave and a sample of hard white rock from its ceiling were submitted to us by the owner. Determinations of carbonate (CO_3) and of silica (SiO_2) were made in the Division of Chemistry of the National Institute of Health and resulted as follows: The dust sample, which passed a 40-mesh sieve, showed approximately 43.9 percent carbonate (CO_3) and 10.2 percent silica

(SiO_2). The hard white rock sample showed 58.5 percent carbonate (CO_3) and 1 percent silica (SiO_2). Both samples contained also magnesium in addition to calcium. The dust showed approximately 2.3 percent and the rock 11.5 percent magnesium (Mg).

Analysis of a sample of dust from another cave harboring infected ticks in San Saba County, Tex., showed 17.6 percent carbonate (CO_3) and 38.8 percent silica (SiO_2). These results indicate that these dusts are mixtures of carbonate and siliceous material, and that the hard rock was chiefly a dolomite limestone.

Floods.—Caves located in proximity to rivers would be subjected to flood waters and to impounded waters in case of artificial dams. Waters entering a cave would probably transport ticks to distant places.

PLAN OF THE EXPERIMENT

Determination of the longevity of tick and spirochete was the principal objective. In order that all ticks might have an even start, all were fed on arrival in 1931 on two fresh *Macacus rhesus* monkeys. One lot of 80 ticks collected in Mills County, Tex., was confined within two tick holders on October 16, 1931, and exposed for 45 minutes directly to the shaved skin of the abdomen of fresh rhesus monkey No. 553, resulting in infection with relapsing fever. (See table 1.)

Another lot of 39 ticks which had been collected in San Saba County, Tex., was confined in a tick holder on October 16, 1931, and exposed for 45 minutes directly to the shaved skin of the abdomen of fresh rhesus monkey No. 552, resulting in infection with relapsing fever.

This demonstration proved that in both lots there were naturally infected ticks, but does not give information as to what percentage of them were infected. All ticks were then starved—some for 3 years, some for 4 years, and the remainder for 5 years. Of the original 119 ticks, 64 survived starvation for 3 years, 35 for 4 years, and 13 for 5 years, beyond which time survival under starving conditions was not tested.

12 ticks starved 3 years infected rhesus No. 896 and became group A.
11 ticks starved 4 years infected rhesus No. 885 and became group B.
13 ticks starved 5 years infected rhesus No. 67 and became group C.
5 group A ticks fed once in 6 years failed to infect rhesus No. 357.
5 group B ticks fed once in 6½ years infected rhesus No. 364.
7 group C ticks will be tested in 1939, after 8 years.

SURVIVAL OF SPIROCHETES

Five years' survival of spirochetes within starved ticks.—Of 64 ticks which had survived starvation for 3 years, 12 (designated group A) were tested for infectivity on November 16, 1934, by confining them

TABLE 1.—*Ornithodoros turicata ticks naturally infected in Texas as tested for longevity under starved and fed conditions, and for duration of virulent infection with Spirochaeta recurrentis*

1931	1932	1933	1934	1935	1936	1937	1938	1939
80 ticks collected in Mills County were exposed Oct. 16, 1931, to fresh rhesus No. 553. Positive.	Starved 1 year.	Starved 2 years.	Starved 3 years	Starved 4 years	Starved 5 years	Group A unfed since Nov. 16, 1934. 5 living, all of which fed Nov. 17, 1937, on rhesus No. 357. Negative. All females.	Group B unfed since Oct. 10, 1935. 7 living, of which 5 fed on rhesus No. 364: 4 fed Mar. 1, 1938, 1 fed Mar. 4, 1938. Positive. All females.	Group C to be fed in 1939.
15 would not feed		(2 given away.)	8 living	4 living	1 living			
65 engorged			43 living	19 living	7 living			
39 ticks collected in San Saba County were exposed Oct. 16, 1931, on fresh rhesus No. 552. Positive.								
5 would not feed	Died							
34 engorged		(11 lost by accident.)	13 living	12 living	5 living			
Total, 119			64 living of which 12 fed Nov. 16, 1934, on rhesus No. 896. Positive. (Group A.)	35 living of which 11 fed Oct. 10, 1935, on rhesus No. 885. Positive. (Group B: 1 male; 10 females.)	13 living all of which fed Sept. 24, 1936, on rhesus No. 67. Positive. (Group C: 3 males; 10 females.)			

in a tick holder and exposing them for 45 minutes directly to the shaved skin of the abdomen of fresh rhesus monkey No. 896; all fed and relapsing fever resulted. Of 35 ticks which had starved 4 years, 11 (designated group B) were tested for infection October 10, 1935, by confining them in a tick holder and exposing them for 50 minutes directly to the shaved skin of the abdomen of fresh rhesus monkey No. 885; all fed and relapsing fever resulted. (See temperature chart 1, rhesus No. 885.) Of 13 ticks (designated group C) which had starved 5 years all were tested for infection on September 24, 1936, by confining them in a tick holder and exposing them for 45 minutes directly to the shaved skin of the abdomen of fresh rhesus monkey No. 67; all fed and relapsing fever resulted. (See temperature chart 2, rhesus No. 67.)

Six and one-half years' survival of spirochetes within ticks fed once.—Group B ticks had been fed once in 1935 (see temperature chart 1, rhesus No. 885), and by the end of 6½ years (March 1, 1938) were reduced in number from 11 to 7. Of the seven, four fed March 1, 1938, on fresh rhesus monkey No. 364 and one fed March 4, 1938, on the same monkey, resulting in infection. (See temperature chart 1, rhesus No. 364.) This demonstrated the survival of virulent spirochetes in ticks which had been fed once (1935) in 6½ years.

REPORTS OF LONGEVITY OF ORNITHODOROS

Reports in the literature of longevity of the genus *Ornithodoros* which have come to my attention are the following:

Nuttall and Warburton reported that *O. moubata*, when fed regularly in captivity, died off gradually after 2 years. They report Megnin as observing *O. megnini* alive unfed for 2 years.

Cunliffe and Nuttall report *O. moubata* females, performing normal functions, living 862 days.

Möllers, employing 110 young *O. moubata* ticks which had been hatched in Africa, fed them on a monkey infected with African relapsing fever. Then every 1 to 2 months he allowed the surviving ticks to feed on a fresh monkey until by the end of 1 year and 8 months they had infected a series of 11 monkeys, 8 of which died. In that time the number of ticks had diminished from 110 to 23. He also transmitted the infection through the egg to the third generation of ticks.

Mayer fed 80 *O. moubata* larvae on a mouse infected with *Trypanosoma cruzi* and thereafter fed them every 3 months on healthy mice. After a little less than 5 years, four ticks were still living and harbored living virulent parasites in the intestines.

Brumpt reported 3 female *O. megnini* as still living at the end of 3 years, 8 months, without ever having laid eggs. Other males and females of the same lot had died sooner.

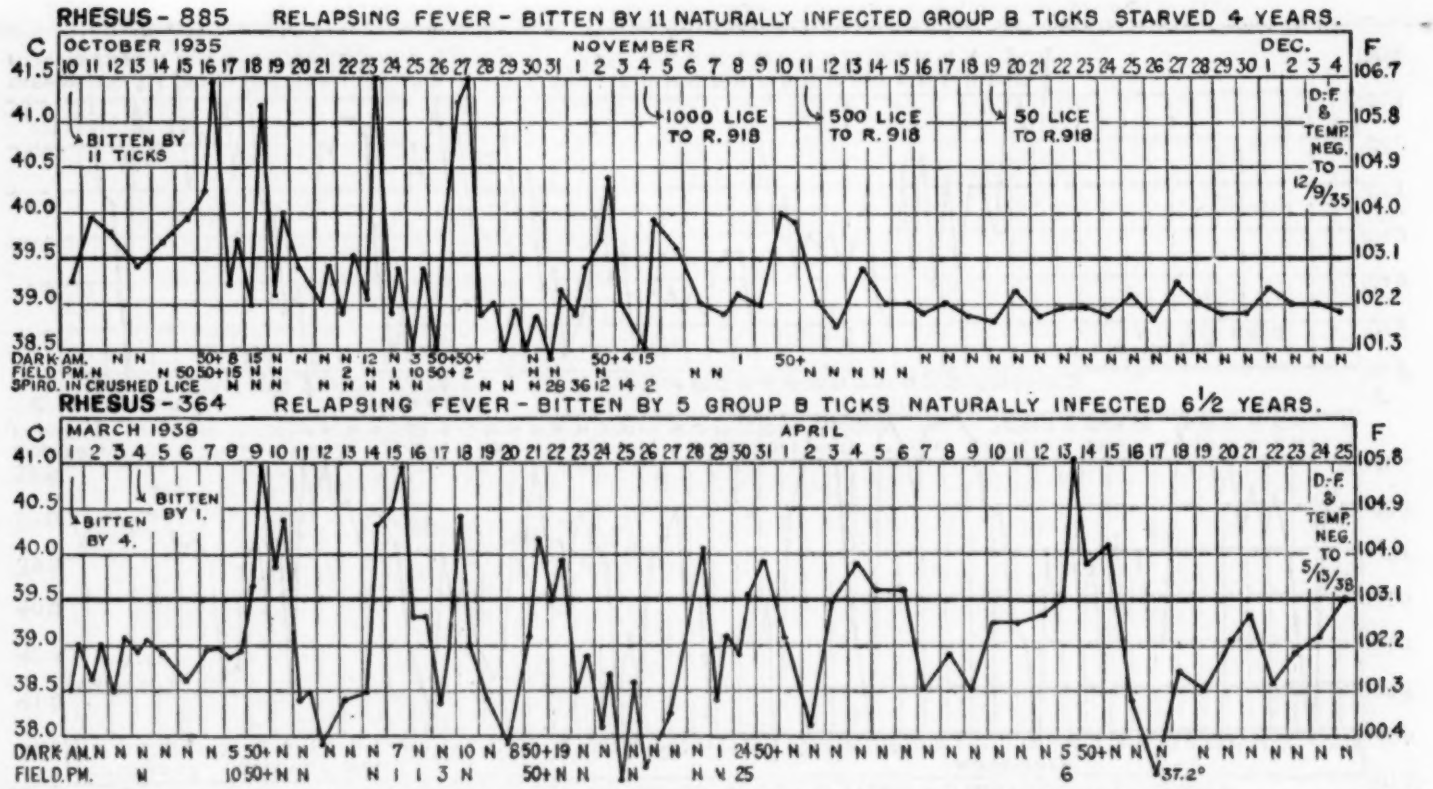

CHART 1.—Relapsing fever in monkeys. Numbers appearing opposite the heading "Dark-field" signify the number of spirochetes seen in an entire cover-glass preparation in a 10-minute search. Large numbers are indicated by 50+, absence of spirochetes by "N."

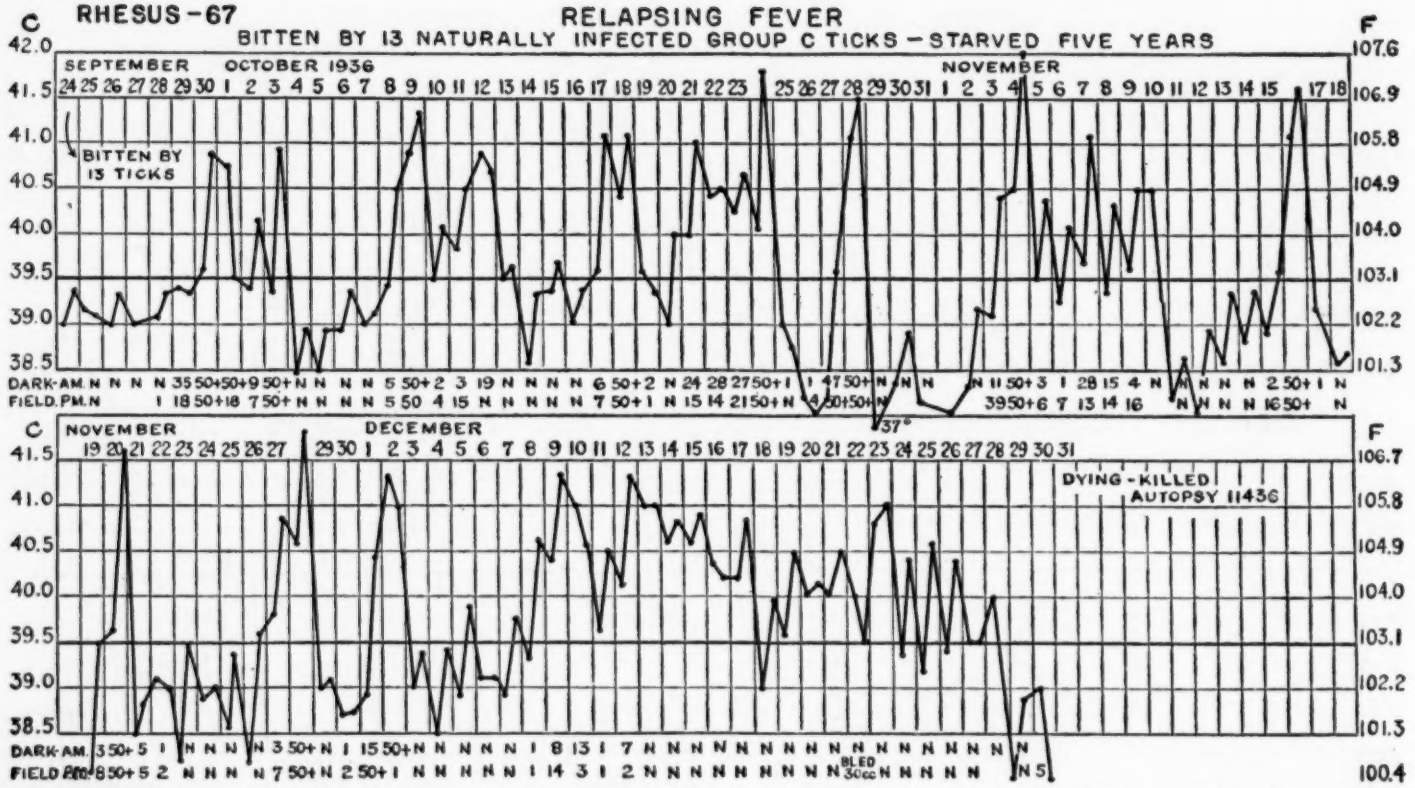

CHART 2.—Relapsing fever in monkey bitten by ticks starved for 5 years. Numbers appearing opposite the heading "Dark-field" signify the number of spirochetes seen in an entire cover-glass preparation in a 10-minute search. Large numbers are indicated by 50+, absence of spirochetes by "N."

Kemp, Moursund, and Wright (1934), working with *O. turicata*, observed fasting for 5 months and a length of life of 2 years, possibly longer.

TRANSMISSION THROUGH THE EGG TO LARVA AND FIRST NYMPH

Hereditary transmission to the next generation of ticks was obtained through eggs from naturally infected ticks and from ticks artificially infected. (See table 2.)

1. *From naturally infected ticks.*—Larvae from naturally infected ticks were injected subcutaneously into two white mice, which became infected; but these particular larvae were not tested for transmission by feeding nor were they raised through the later stages for tests of infectivity.

Ticks sent from Mills County, Tex., September 10, 1931, were fed October 16, 1931, on rhesus No. 553 and they deposited their first eggs on May 8, 1932. On June 16 and again on June 17, 1932, 50 unfed larvae were injected subcutaneously into a white mouse, which became positive for spirochetes June 21. Also, naturally infected ticks sent September 10, 1931, from San Saba County, Tex., were fed October 16, 1931, on fresh rhesus No. 552, and they deposited their first eggs May 13, 1932. On June 17, 1932, 30 unfed larvae were injected subcutaneously into a white mouse, which became positive for spirochetes June 24.

2. *From artificially infected ticks.*—Larvae and first stage nymphs, the preceding generation of which had been infected as second, third, and fourth stage nymphs and adults by feeding on artificially infected white mouse, white rat, or rhesus monkey, transmitted the infection, by feeding, to three white mice, one rhesus monkey, and one man. Transmission by stages later than first stage nymphs was not attempted, because of loss of the nymphs from neglect. Details of the transmission experiments are summarized in the following, under the headings Tick No. 30 and Tick No. 24.

Tick No. 30.—Adult female *O. turicata* No. 30 was one of 11 group B Texas ticks which infected rhesus No. 885 on October 10, 1935. Eggs were not deposited until May 9, 1936. Larvae and first stage nymphs failed to infect a white mouse on which they fed. Therefore the second, third, and fourth stage nymphs were engorged on infected white mice and white rats. Four adults which engorged on fresh rhesus No. 918 on April 2, 1937, deposited eggs which hatched, and 384 pooled larvae were fed in lots of 75 each on 5 fresh white mice, only 1 of which became infected. Also 18 pooled larvae which had fed were injected 5 days later intraperitoneally into a fresh white mouse, with negative results. First stage nymphs numbering 359 engorged on fresh rhesus No. 75 and infected him. Unfortunately this lot of hereditarily infected first nymphs was lost from neglect before later stages could be tested for infectivity.

Tick No. 24.—Adult female No. 24 belonged to group B of 11 ticks which infected rhesus No. 885 on October 10, 1935. Eggs were first desposited June 1, 1936. Larvae and first stage nymphs engorged on a white mouse, which remained free from infection. Second, third, and fourth stage nymphs engorged on an infected white mouse or infected white rat. Five adults which engorged May 19, 1937, on infected rhesus No. 918, deposited eggs which hatched to larvae, 175 of which were pooled and fed on a white mouse June 20, 1937, infecting it, and 270 larvae were pooled and fed June 21, 1937, on a white mouse, infecting it.

TABLE 2.—*Reaction of man, monkey, and mouse following bites of naturally infected and hereditarily infected ticks*

Rhesus monkey, man, or mouse	Bitten by ticks			Incubation in days		Reaction in the animal			Serological tests				
	Date	Number of ticks	Age of ticks	Until spirochetes were seen in dark field	Until onset of fever	Number of relapses	Duration of fever (days)	Termination	Date of bleeding	Time after onset	Wassermann	Kahn	Agglutination: *B. tularense*, *Br. abortus*, *B. typhosus*, *Proteus X19*
(1) NATURALLY INFECTED													
R553	10/16/31	65	Adults—late nymphs	5	6	4	33	Recovery					
R552	10/16/31	34	do	5	5	6	34	do					
R896	11/16/34	12	Adults, group A, starved 3 years.	4	5	6	48	do					
R885	10/10/35	11	Adults, group B; starved 4 years.	5	5	4	25	Immunity test.	10/23/35	8 days			Negative.
R67	9/24/36	13	Adults, group C; starved 5 years.	4	6	8	90	Stiff back; death A[1].	12/22/36	83 days	Negative	Negative	Do.
R357	11/17/37	5 females	Group A, 6 years	None	None	None	None	Immunity test.					
R364	3/ 1/38	do	Group B, 6½ years	4 or 7	5 or 8	5	37	Recovery	4/14/38	36 days	Negative	Negative	Do.
									5/26/38	78 days	do	do	Do.
									9/28/38	7 months	Weak positive.	1 plus	Do.
(2) ARTIFICIALLY INFECTED													
R918	4/ 2/37	12	Adults, 2 months	3	5	2	44	Recovery; stiff back.					
Ditto	5/19/37	17	Adults, 1 to 4 months					Immunity test.					

(3) HEREDITARILY INFECTED

R75	6/22/37	359	First-stage nymphs	5	6	1	[2]16	Immunity test.						
Man (E. F.)	6/20/37	1	Larva, 9 days	7 or 8	6 or 7	8	100	Recovery	2/21/38	8 months		Negative (Hinton).	B. tul. Pos. 80; Br. abor. Pos. 20.[3]
Do	6/21/37	1	Larva, 10 days						5/26/38	11 months	Negative	Negative	
Mouse 1	6/20/37	175	Larvae, 9 days	3				Immunity test.						
Mouse 2	6/21/37	270	Larvae, 10 days	3				do						
Mouse	5/30/37	70	Larvae, 12 days	7				do						

IMMUNITY TESTED BY BLOOD FROM MONKEY 364

	Date of injection	Amount of blood[4]	Time since onset of previous attack										
R918	3/30/38	I. P. 2 cc	1 year	4	5	None in 26 days.		Recovery	5/26/38	14 months or 52 days.	Weak positive.	2 plus	Negative.
									9/28/38	18 months or 6 months.	Positive	1 plus	Do.
R75	3/30/38	do	9 months	2	3	2 in 26 days.		do	5/26/38	11 months or 55 days.	Anticomp	Negative	Do.
R357	3/30/38	do	No previous attack	2	3	3 in 26 days.		do	5/26/38	54 days	Positive	2 plus	Do.
									9/28/38	6 months	Strong positive.	4 plus	Do.
Mouse 1	3/30/38	I. P. 1 cc	9 months	1		1 in 13 days.		do					
Mouse 2	3/30/38	I. P. 0.5 cc	do	1		2 in 13 days.		do					
R885	10/ 9/36	S. C. 1 cc from monkey No. 67.	1 year	7	8	5 in 94 days.	94 days	Death; stiff back.[5]	3/11/37	17 months or 5 months.	Negative	Negative	Do.

[1] Death of R67 occurred 93 days after onset of infection. Careful autopsy (11436), microscopic pathological examination, and injection of tissues into 37 guinea pigs failed to give evidence of tuberculosis.

[2] Not recorded longer.

[3] Had tularaemia in 1919 and brucellosis in 1928.

[4] I. P.=intraperitoneally; S. C.=subcutaneously.

[5] Death of R885 occurred Mar. 11, 1937, 5 months after receiving subcutaneous injection with infected blood in immunity test. Autopsy (11788), microscopic pathological examination, and injection of 18 guinea pigs with spleen, liver, and lung failed to demonstrate tuberculosis.

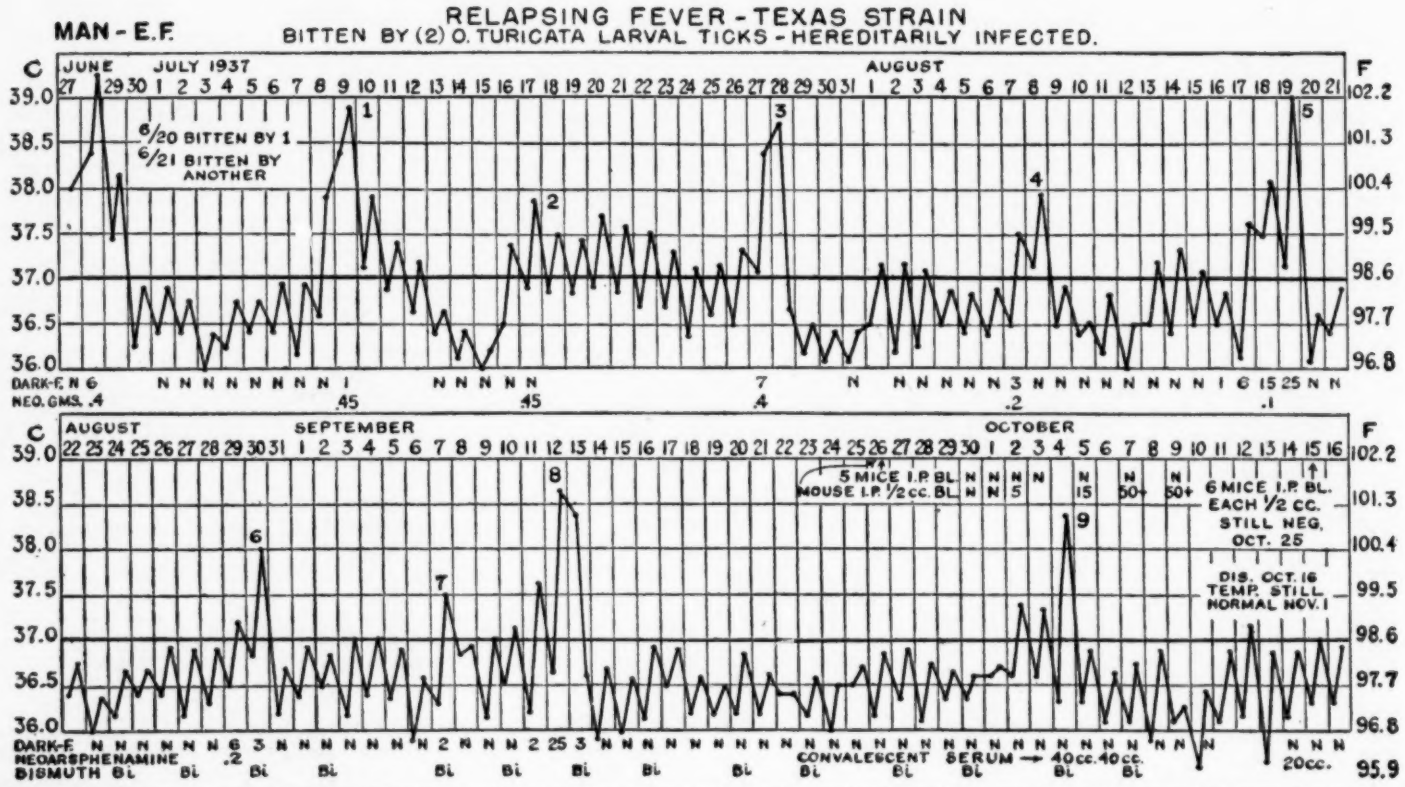

CHART 3.—Relapsing fever in man. Numbers appearing opposite the heading "Dark-f." signify the number of spirochetes seen in an entire cover-glass preparation in a 10-minute search. Large numbers are indicated by 50+, absence of spirochetes by "N."

One larva accidently escaped observation during the feeding on June 20 and was found engorged 10 minutes later moving from a hidden position in the web between the ring finger and little finger of the left hand on E. F. Another larva accidently escaped during the feeding on June 21 and quickly engorged on E. F. without being noticed in the web between the ring finger and middle finger of his left hand, resulting in infection June 27. (See temperature chart 3 of man E. F.) All larvae were later lost from lack of attention.

TRANSMISSION BY INGESTION OF INFECTED BEDBUGS

Survival of *Sp. recurrentis* in bedbugs *Cimex lectularius* for over 5 months was reported by Rosenholz and by Francis (1932), who obtained transmission by injection of bugs 190 days after their last infective feed but failed to obtain transmission by feeding bugs on white mice. Transmission to white mice by ingestion of infected bedbugs is here reported in four of eight experiments. The source of the fresh bedbugs was the animal cages in which the guinea pigs of the laboratory were kept. Table 3 shows the four successful experiments in which mice Nos. 1 and 4 ate bugs which had four infective feeds, mouse No. 2 ate bugs which had two infective feeds, and mouse No. 3 ate bugs which had one infective feed. The incubation periods in the mice were 4, 4, 5, and 6 days. The four unsuccessful experiments were conducted along the same lines as the four successful ones. White mice readily attack and eat bedbugs, especially if the mouse jar is free from bedding or other hiding place for the bugs and if food has been withheld from the mouse for 24 hours.

Francis and Lake reported 55 successful bug-eating experiments in tularaemia, in three of which the ingestion of a single bug which had been infected 100 days previously resulted in transmission of the disease.

Dutton and Todd, referring to *Ornithodoros moubata*, state that "rats eat adults with avidity" and are quoted by Nuttall and Warburton thus: "Under natural conditions in the Congo, they (*O. moubata*) are devoured by rats and mice."

Experiments in other fields of research designed to demonstrate transmission by fleas often have permitted the unrestricted presence of rodents and fleas in the same container. Such a procedure leaves the question in doubt as to whether the insect bit the rodent or the rodent bit the insect.

Double infection.—In selecting fresh mice for our bug-eating experiments in relapsing fever, one mouse which was naturally infected with *Spirochaeta morsus muris* was unintentionally included and became mouse No. 4 in table 3. In this mouse, *Sp. recurrentis* and *Sp. morsus muris* ran their usual characteristic normal courses without antagonism, the former disappearing after 12 days while the latter was seen at all examinations for 1 year. This instance of spontaneous infection led Francis (1936) to find among the laboratory stock of white mice, 65 that were naturally infected with *Sp. morsus muris*.

TABLE 3.—*Transmission of Sp. recurrentis to mice by ingestion of infected bedbugs*

Fresh mice	Bugs engorged on infected animal	Bugs ingested by white mouse	Blood of mouse became positive		Incubation period in mouse
Mouse 1	Oct. 27, 1935 Nov. 3, 1935 Nov. 10, 1935 Nov. 25, 1935	Nov. 25, 1935, ate 17 bugs in 2 hours.	Nov. 30, 1935.		5 days.
Mouse 2	Dec. 20, 1935 Dec. 29, 1935	Dec. 29, 1935, ate 20 bugs in 10 minutes.	Jan. 4, 1936.		6 days.
Mouse 3	Dec. 31, 1935	Dec. 31, 1935, ate 30 bugs.	Jan. 4, 1936.		4 days.
Mouse 4 double infection.	Dec. 19, 1935	Dec. 19, 1935, ate 24 bugs.	MOUSE 4, BLOOD EXAMINED IN DARK-FIELD		
	Nov. 25, 1935 Dec. 3, 1935 Dec. 20, 1935	Dec. 20, 1935, ate 24 bugs.	Date	*Sp. recurrentis*	*Sp. morsus muris* (naturally infected)
			Dec. 21, 1935	Negative.	12 seen.
			Dec. 22, 1935	Do.	26 seen.
			Dec. 23, 1935	2 seen.	24 seen.
			Dec. 24, 1935	12 seen.	24 seen.
			Dec. 25, 1935	48 seen.	12 seen.
			Dec. 26, 1935	Negative.	7 seen.
			Dec. 28, 1935	31 seen.	13 seen.
			Dec. 30, 1935	4 seen.	8 seen.
			Jan. 1, 1936	1 seen.	18 seen.
			Jan. 3, 1936	7 seen.	31 seen.
			Feb. 21, 1936	Negative.	18 seen.
			Mar. 23, 1936	Do.	15 seen.
			June 25, 1936	Do.	3 seen.
			Dec. 21, 1936	Do.	5 seen.
			Feb. 21, 1937	Mouse dead.	

Sp. morsus muris not transmitted by ingestion of bedbugs.—In eight bug-eating experiments, this spirochete could not be transmitted to white mice. Eight lots of bugs averaging 30 per lot were allowed to engorge on white mice heavily infected with *Sp. morsus muris*, one of which was mouse No. 4 of table 3. After engorgement, the bugs were promptly eaten by eight white mice which, by dark-field examination on alternate days, remained negative for 40 days.

MONKEY LICE FAILED TO TRANSMIT THE INFECTION

Monkey lice, *Pedicinus longiceps* Piaget, are frequently found on rhesus monkeys in the laboratory. Rhesus No. 885 was heavily infested with that species at the time he was tick bitten October 10, 1935, and throughout his febrile period. (See temperature chart 1 rhesus No. 885). This furnished an excellent opportunity to test the transmission of spirochetes from monkey to monkey by bites of infected monkey lice. To this end, lice were combed from infected monkey No. 885 and transferred to fresh rhesus No. 918, but the latter failed to become infected.

In order to be sure of the presence of spirochetes in the lice of monkey No. 885, they were examined almost daily from October 17 to 30 in lots of four each, each lot being crushed in saline solution and examined in dark-field; no spirochete was seen in a louse until October 31. Abruptly on October 31 and again November 1, 2, 3, and 4, spirochetes were present in dark-field examination of saline preparations of lice removed on those dates from rhesus No. 885, and mice into which the positive saline suspensions were injected promptly became positive.

Consequently, lice were combed from rhesus No. 885 on three occasions and immediately liberated in great numbers in the hair of fresh rhesus No. 918, i. e., November 4, 1935, 1,000 lice; November 11, 500 lice, and November 19, 50 lice. Rhesus No. 918 was examined once each day from November 4 to December 10, 1935, for elevation of temperature and by dark-field for spirochetes in his blood with entirely negative results and was kept under ordinary observation from December 11, 1935, to March 13, 1937, but remained apparently well.

Summarized results of this experiment show (1) that spirochetes could not be demonstrated in lice during the first 16 days (October 15 to 30) of their subsistence on spirochete-positive monkey blood but were demonstrated daily from the 17th to 21st day of such continuous subsistence and (2) that these infected lice failed to infect a rhesus monkey on which they were liberated—1,000 on the 21st day mentioned, 500 on the 28th day, and 50 on the 36th day of continuous residence on the infected monkey.

NOTES ON THE LIFE HISTORY OF O. TURICATA

Constant temperature regulation had no place in our tick rearing. For seven years these operations have been conducted in a corner of a laboratory room in Washington occupied daily by personnel but from which steam heat was excluded in the winter.

Engorgements in September, October, or November of three different years by 5 different groups of ticks were not followed by deposits of eggs before the following May, but engorgements in April or May were followed by oviposition in 20 days and 9 days, respectively.

Development from egg to adult consumed 9 months 10 days in the case of eggs deposited June 1, 1936, by adult No. 24. *Nymphal* stages usually number four, but 5 nymphal stages were observed in four females and only 3 nymphal stages were noted in one male. Accurate data on these points are best obtained by separation of the individuals between feedings, beginning after the first nymphal feed.

Longevity of males and females.—Of 119 original ticks collected in nature, 26 were living 5 years 6 months later, and of these, 2 were

males and 24 were females. At the end of 6 years 6 months in captivity, 20 survived, of which 1 was a male; the latter died 2 months later. At the end of 7 years, 14 are living, all females.

Length of life after oviposition.—Three specimens are living 24 months after oviposition; two died 22 months and 12 months, respectively, after oviposition without again feeding.

Cannibalism.—A starved male and a starved female were applied to the tail of a fresh mouse. The male fed to engorgement in 30 minutes but the female would not feed. They were placed together over night in a pine block and in the morning the female was found riding the male and firmly attached with the palps well spread and the hypostome inserted through the dorsum of the male at a point near its left margin opposite the space between the second and third left legs; the female was no longer flat and shriveled but was distended. On being detached, a drop of dark fluid arose from the wound.

While attempting to feed 12 fourth stage nymphs on the tail of a white rat, one was pierced near the right margin of the dorsum opposite the second leg by an unfed nymph which became loosened during manipulation, leaving a rounded drop of dark fluid at the site of the puncture which was plainly visible the next day.

Coxal fluid.—On many occasions coxal fluid which was secreted at the time of feeding was examined in the dark-field for spirochetes, with negative results, nor could spirochetes be demonstrated in white mice into which coxal fluid was injected.

Absence of moisture.—Infected larvae (445) were fed on June 20 or June 21, 1937, on two white mice and thereafter confined at room temperature in glass tubes supplied with air but without provision for moisture. All except 13 were dead on November 11, 1937, in a mass of shed skins.

First stage infected nymphs (359) were fed on a monkey June 22, 1937, and were thereafter confined in cotton-stoppered glass tubes without moisture, at room temperature, until March 16, 1938, when all were dead in a mass of shed skins.

Recently fed young infected adults (12 males and 16 females) were placed at room temperature in glass tubes stoppered with cotton, but unsupplied with moisture, from July 1937 to March 16, 1938; on the latter date all were dead except one male and one female, both of which were transferred to a moist pine chamber and were living 6 months later.

Submersion in water.—Experiments which we conducted in the laboratory to determine the effect of submersion on the life of *O. turicata* adult ticks showed that five males and five females resisted continuous submersion 2 inches below the surface of distilled water for a week without ill effects. Since they could not swim, they did not reach the surface of the water during that time.

Maintenance of a laboratory strain of spirochetes.—Rat to rat transfer combined with ice-box preservation of infected rat blood is frequently employed for maintaining a strain, but it would seem that infected bedbugs and ticks might afford a less laborious and surer method.

REACTION IN THE MACACUS RHESUS MONKEY FROM TICK BITES

Rhesus monkeys are very susceptible to relapsing fever. Tick engorgement is usually complete in 30 to 45 minutes, and the ticks detach from the abdomen leaving very evident sites of bites corresponding in number to the number of ticks. Each bite is a hemorrhagic, edematous, raised, circular, 3 to 6 millimeter papule in the center of which is a red point. Diffuse redness and edema may extend to the pubes if the number of ticks is great. The discrete red papules are evident for approximately a week, after which they become pale, the central point being the last to fade. Coxal fluid usually exudes during feeding and afterward from the bottom of the deep groove between the first and second legs and may surround the ticks and their bites, forming a pool. The incubation period in eight tick-bitten monkeys was remarkably constant (see table 2) and averaged 4⅜ days to the first appearance of spirochetes in the dark field and 5⅝ days to the first onset of fever after the tick bite. This same earlier appearance of spirochetes, 24 hours in advance of fever, was observed also in the relapses of the human case. During a febrile paroxysm a monkey is evidently ill. A sequella of the disease in three monkeys was permanent rigidity of the spine, which was curved anteroposteriorly. This was accompanied by flexure of the thighs against the abdomen. There was no paralysis, but loss of motility compelled a sitting posture in the cage without any tendency to climb to the top of the cage. Handling such a monkey produced pain. This condition was very prominent in monkeys Nos. 67 and 885, which died, and in monkey No. 918. A double peak to the febrile attacks is plainly shown in temperature charts of monkeys Nos. 67 and 885. Monkeys did not show immunity to second attacks.

METHODS OF FEEDING TICKS ON ANIMALS

1. *Tick holder.*—Ticks were confined in a tick holder (fig. 1), which is slightly modified from that described by Jellison and Philip in that it is provided with a ⅝-inch pasteboard collar. It is made as follows: The metal screw top is cut from a pasteboard mailing tube, carrying with it a ⅝ inch width of pasteboard collar. With a pair of tinner's shears, numerous snips are made in the crimped metal which holds the screw top to the pasteboard. With pliers, these small metal strips are bent at a right angle, forming a flange. A band of adhesive plaster, 3 inches wide, in which a 2-inch circular hole has been cut.

snugly fits against the flange and tightly encircles the monkey's abdomen, the ends overlapping, thus pressing the circular margin of the pasteboard collar firmly against the shaved skin. This is essential to prevent the escape of ticks from the chamber, in which case they would become enmeshed in the adhesive plaster and lost. Introduce the ticks and apply the threaded screw lid in which small holes have been punched for ventilation, if desired. The margins of the 3-inch adhesive plaster girdle may be overlapped by encircling strips of 1-inch adhesive plaster. Still firmer contact between tick holder and the animal's abdomen can be obtained by finally applying a narrow band of adhesive plaster tightly over the lid and around the animal's body.

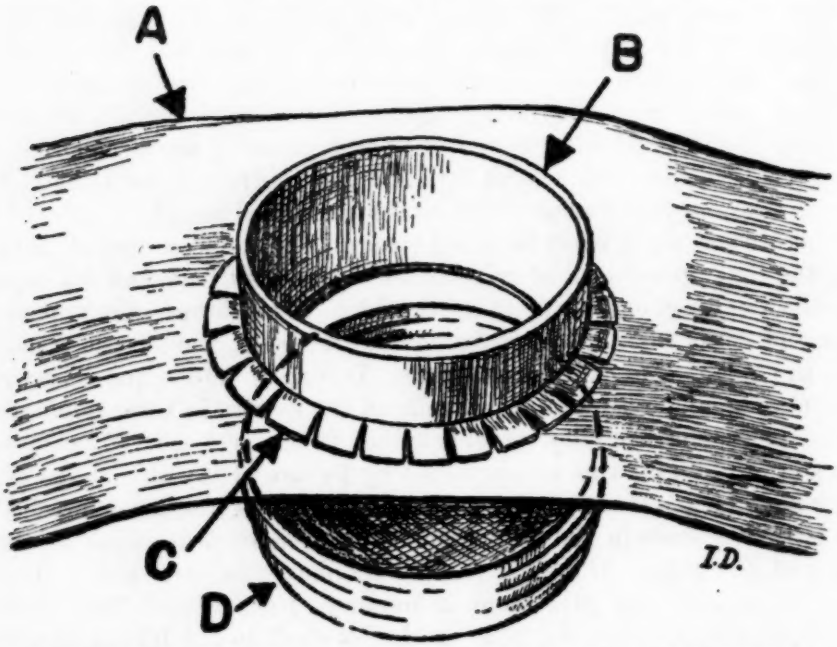

FIGURE 1.—Tick holder (inverted view). A, band of adhesive plaster, 3 inches wide, showing the sticky surface. B, pasteboard collar, 5/8 inch wide. C, metal flange against the sticky adhesive plaster. D, metal screw lid.

2. *Monkey holder.*—Monkeys were held in restraint for tick feeding on an animal board (fig. 2), designed by attendant Elmer Wiseman of this Institute.

3. *Mouse or rat holder.*—Larval ticks are so small and the danger of escape is so great that they are best fed on the tail of a white mouse or white rat, using the apparatus shown in figure 3. The mouse holder rests on a board occupying the center of a pan of disinfectant to prevent the escape of infected ticks.

Conditions under which ticks were kept.—In the laboratory the ticks were kept in cubical pine blocks (fig. 4) in which a chamber had been bored out with a 1¾-inch auger; the opening to the chamber was

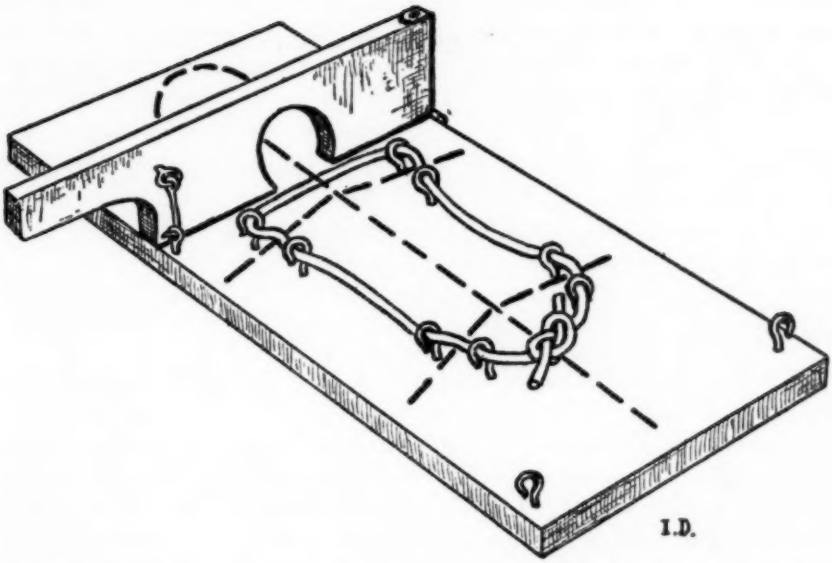

FIGURE 2.—Monkey holder for feeding ticks on the abdomen. A hinged collar immobilizes the head. Rubber tubing passes under the neck, through the open screw eyes, over the front and hind legs and is tied in a knot. Two extra screw eyes are for tieing the hind feet.

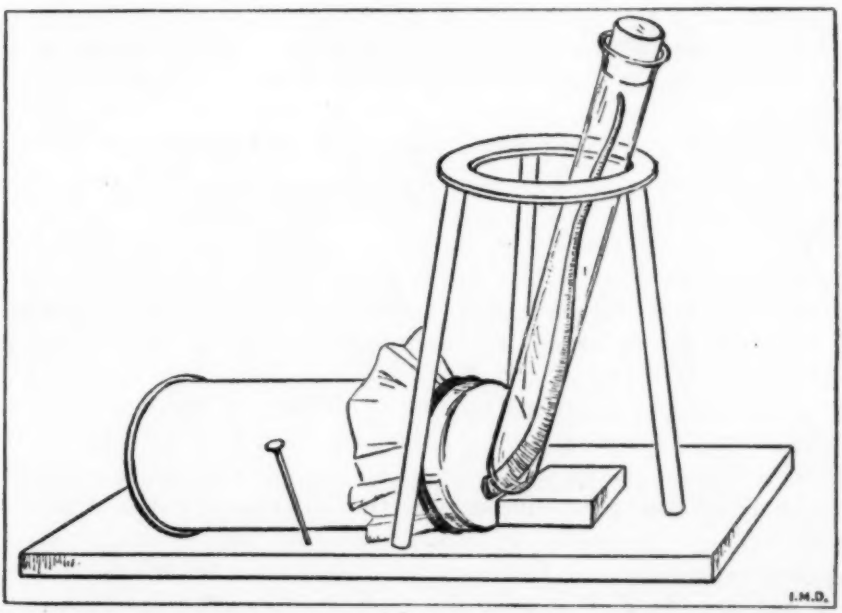

FIGURE 3.—Rat or mouse holder for feeding ticks upon the tail. Animal is confined in a pasteboard mailing case of such size that it fits snugly. The closed metal end is punctured with holes and the open end is closed with cloth and a rubber band. The tail protrudes through a hole in the cloth and through a tightly fitting hole in the bottom of the upright glass tube. Introduce small ticks or bedbugs from a funnel and apply the stopper.

closed with a cork stopper. The blocks rested on sand, to which water was added about once a month. Moisture traveled from the sand through the wood to the air of the tick chamber. Care must be taken not to allow the wood to become too moist from excessively wet sand, because moulds will develop within the chamber. No attempt was made to regulate the temperature, which was that of the laboratory room in which personnel worked summer and winter. To avoid accidental escape of the ticks the glass sand containers were kept in a pan and surrounded by a disinfectant solution. The number of ticks per block varied from 1 to about 12.

DARK-FIELD EXAMINATIONS

Dark-field examination of fresh blood from the tail of a mouse or the ear of a monkey was used exclusively. The equipment consists of a dark-field substage condenser, a 4-millimeter objective, and a strong bulb light. Oil immersion lens with funnel stop is neither necessary nor desirable. The blood preparation should be as thin as possible. Thinness is obtained by forcibly pressing on the cover glass with a blotter, which absorbs the excess blood as it emerges at the margins of the cover glass. I prefer to make pressure by inverting the slide and cover glass on a roll of toilet paper, making strong pressure downward with the thumb on the under side of the slide, giving no attention to thumb marks. A preparation which is so thin that there are spaces between blood corpuscles forces the spirochetes into plain view in contrast to their hidden position in thicker preparations. Immersion oil is applied between substage and slide. With a mechanical stage an entire preparation may be searched systematically in 10 minutes; no examination is reported negative in less than that time.

The numbers appearing on the accompanying temperature charts opposite the heading "Dark-F" signify the number of spirochetes seen in an entire preparation in a 10-minute search. In exceptional instances, where only one or two spirochetes are recorded, the search may have been extended to a half hour or an hour. Great numbers of spirochetes are indicated by 50+ and absence of spirochetes is indicated by N for negative. Comparison of the human temperature chart with the monkey charts shows a sparsity of spirochetes in the human blood and great numbers in the monkey and in the mouse blood. The daily dark-field examinations of the human blood in August, September, and October, 1937, were made by Passed Assistant Surgeon E. T. Ceder at the United States Marine Hospital, Baltimore, Md. (Bohls and Schuhardt emphasize their preference for thick blood films which were not used in this study.)

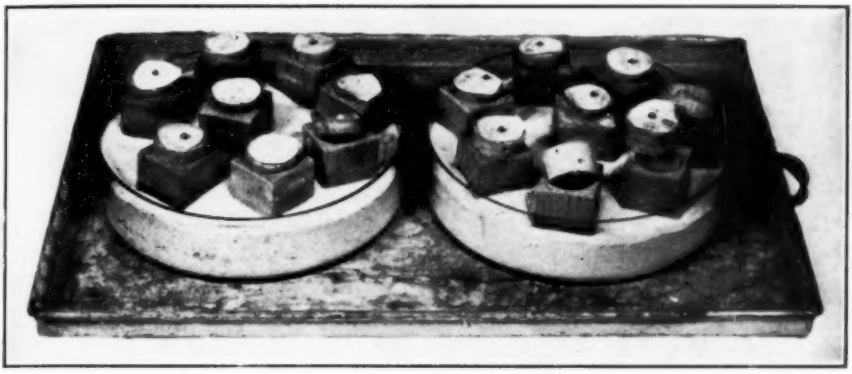

FIGURE 4.—Tick village. Pine block cubicles, dishes of moist sand in pan of disinfectant solution.

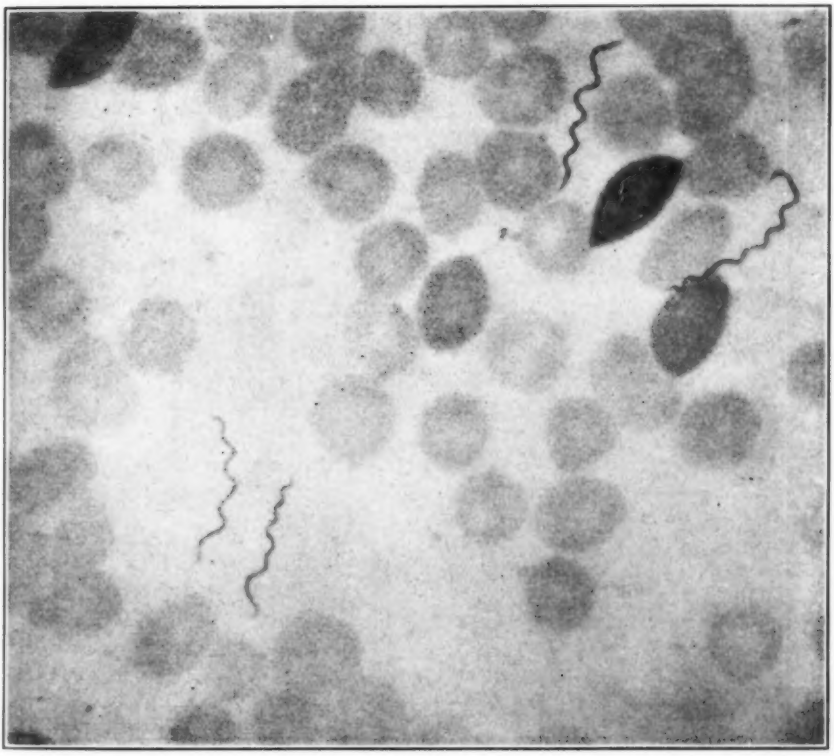

FIGURE 5.—*Spirochaeta recurrentis*, Texas strain, in blood of white mouse. (A. M. M. 50437.)

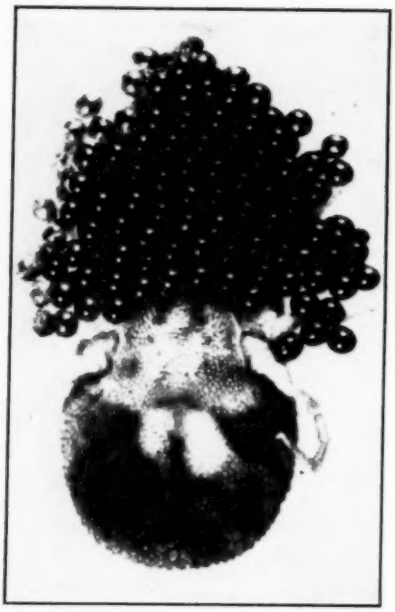

FIGURE 6.—*Ornithodoros turicata* depositing eggs. Ventral view. (N. I. H. 647.)

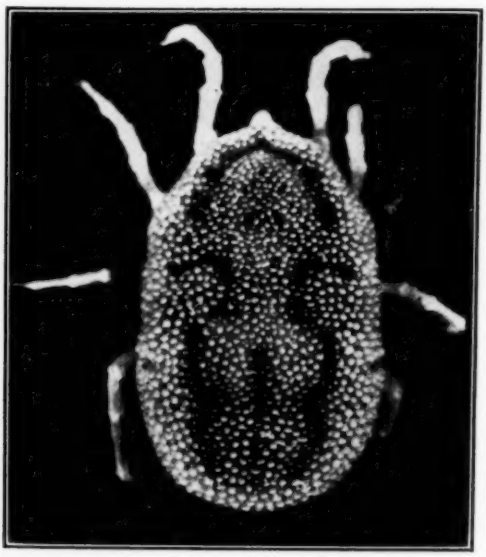

FIGURE 7.—*Ornithodoros turicata* adult female. (N. I. H.)

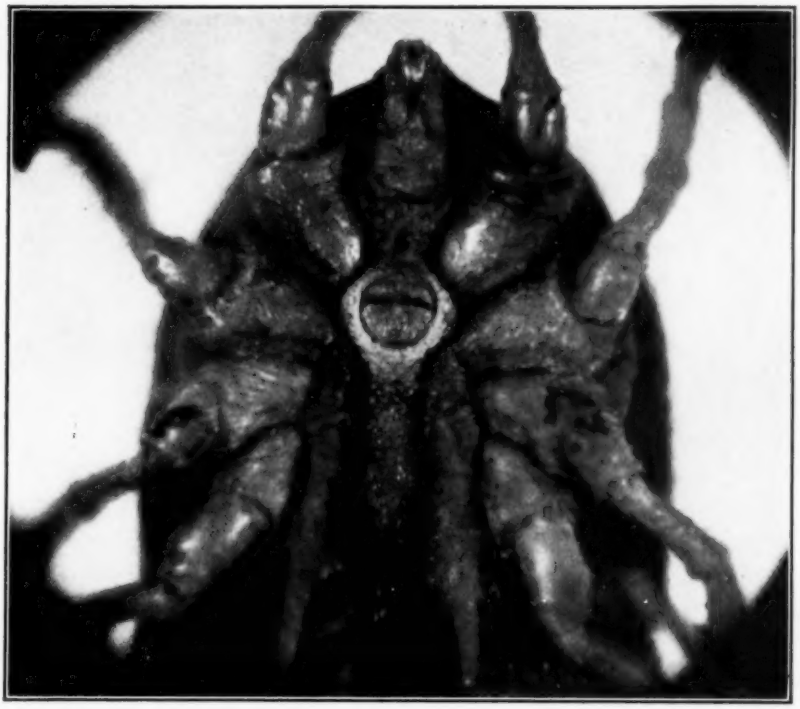

FIGURE 8.—*Ornithodoros turicata*, showing transverse genital orifice. (N. I. H. 616.)

FIGURE 9.—*Ornithodoros turicata* male, showing semicircular genital orifice. (N. I. H. 619.)

IMMUNITY

Table 2 shows that three rhesus monkeys and two white mice which received intraperitoneal injection with infected blood 9 months to 1 year after a previous attack of relapsing fever, all became reinfected within the usual incubation period of the disease. Regarding human cases in Texas, Kemp, Moursund, and Wright (1935) received a number of reports of cases in which the diagnosis was confirmed a second time by demonstrating the organism in blood films; among these cases were those whose first attack was diagnosed very early and was treated promptly with neosalvarsan.

TREATMENT

Many authors dismiss treatment with the bare statement that arsphenamine is specific. This statement should be radically modified before acceptance. Temperature chart 1 (man E. F.) illustrates a case, patient aged 65, unsuccessfully treated with neoarsphenamine D–R–L; two other laboratory cases which were also infected with the Texas strain failed to respond to neoarsphenamine. One of the latter (G. G.) received 0.5 gram of neoarsphenamine at each of four relapses and recovered without further relapse. The other case (C. B. K.) received 0.45 gram of neoarsphenamine immediately after the onset fever had terminated and at each of the first two relapses, but he had three more relapses untreated with neoarsphenamine. Plaut and Steiner unsuccessfully treated with neosalvarsan relapsing fever in paretics who had been infected as a therapeutic measure. Deep injections into the buttock with bismuth preparations were given to E. F., the first 4 injections being with bismuth salicylate in oil, 0.13 gram, and the last 10 being with thio-bismol 3 grains each. He also received convalescent serum intravenously in doses of 40, 40, and 20 cubic centimeters, beginning with the ninth relapse, which was followed by recovery. The convalescent serum was collected from G. G. 7½ months after he was infected February 5, 1937, with the Texas strain. Todd claims great success in treating African relapsing fever in Africans by intramuscular injections of sodium potassium bismuth tartrate.

CONCLUSIONS

Ornithodoros turicata ticks, collected in dry caves in Texas and naturally infected, harbored virulent *Spirochaeta recurrentis* and transmitted relapsing fever, after 5 years of starvation, to a monkey on which they fed. Ticks, which infected a monkey after 4 years of starvation, infected another monkey by feeding 2½ years later, thus demonstrating 6½ years of natural infection in ticks.

Of 119 *Ornithodoros turicata* ticks collected in caves in Texas in 1931, 14 are still living at the end of 7 years, all of which are females.

Hereditary transmission of relapsing fever spirochetes was obtained through the eggs from naturally infected ticks and from ticks artificially infected, to larvae and first nymphs of the next generation, which by feeding infected mouse, monkey, and man.

Transmission was successful when white mice ate bedbugs infected with *Sp. recurrentis*, but failed when mice were bitten by infected bedbugs, *Cimex lectularius*.

Spirochetes could not be demonstrated in monkey lice during the first 16 days of subsistence on spirochete-positive relapsing fever monkey blood, but were demonstrated daily after the seventeenth day; these infected lice failed to infect a monkey on which 1,550 of them were liberated.

Immunity to relapsing fever could not be demonstrated in mouse or monkey 9 months to a year after their original infection.

Neoarsphenamine failed to show specific therapeutic value in 3 human cases infected with the Texas strain of relapsing fever.

REFERENCES

Bohls, S. W., and Schuhardt, V. T.: Relapsing fever in Texas and the laboratory methods of diagnosis. Texas State J. of Med., **29**: 199 (1933).

Brumpt, E.: Contribution à l'étude de l'évolution des ornithodores. Biologie et longévité de *l'Ornithodoros megnini*. Annals de Parasitologie, **14**:647 (1936).

California State Dept. of Public Health, Relapsing Fever. Special Bull. No. 61 (1936).

Cunliffe, N., and Nuttall, G. H. F.: Some observations on biology and structure of Ornithodorus moubata Murray, with note on external characters which serve to differentiate the sexes. Parasitol., **13**: 327 (1921).

Dutton, J. E. and Todd, J. L.: The nature of human tick-fever in the eastern part of the Congo Free State. Liverpool School of Tropical Medicine, Memoir 17, 1905.

Francis, Edward, and Lake, G. C.: Tularaemia Francis 1921. IV. Transmission of tularaemia by the bedbug *Cimex lectularius*. Pub. Health Rep., **37**: 83 (1922).

Francis, Edward: Rat-bite fever and relapsing fever in the United States. Trans. Assoc. Am. Physicians, **47**: 143 (1932).

Francis, Edward: Rat-bite fever spirochetes in naturally infected white mice, *Mus musculus*. Pub. Health Rep., **51**: 976 (1936).

Graham, Malcolm: Relapsing fever endemic in Texas: Possibility of an animal reservoir. Texas State J. of Med., **27**: 226 (1931).

Jellison, W. L., and Philip, C. B.: Technique for routine and experimental feeding of certain ixodid ticks on guinea pigs and rabbits. Pub. Health Rep., **48**: 1081 (1933).

Kemp, H. A., Moursund, W. H., and Wright, H. E.: Relapsing fever in Texas. Am. J. Trop. Med., **13**: 425 (1933); **14**: 159, 163, and 479 (1934); **15**: 495 (1935).

Mayer, Martin: Über den Dauerparasitismus von *Schizotrypanum cruzi* bei *Ornithodorus moubata*. Archiv. f. Schiffs-und Tropen-Hygiene, **22**: 158 (1918).

Möllers, B.: Experimentelle Studien über die Uebertragung des Rückfallfiebers durch Zecken. Zeitschr. f. Hygiene und Infekt., **58**: 277 (1907).

Nuttall, G. H. F., and Warburton, Cecil: Ticks, a Monograph of the *Ixodoidea*. Cambridge University Press, 1908.

Plaut, F., and Steiner, G.: Recurrensinfektionen bei Paralytikern. Zeitschr. f. Gesamte Neurologie und Psychiatrie, Originalien, **53**: 103 (1920).

Rosenholz, H. P., and Gilbert, M. J.: Weitere Untersuchungen über die Rolle der Wanzen in der Epidemiologie des Rückfallfiebers. Centralbl. f. Bakteriol. (Abt. 1), **103**: 348 (1927).

Science Service. Starvation Record Set as Ticks Survive for Five Years, etc. Science News Letter, **30**: 278 (1936).
Todd, John: Treatment of relapsing fever. Brit. Med. J., **1**: 312 (1930).
U. S. Public Health Service. Annual Reports of the Surgeon General for 1934, 1935, 1936, 1937, 1938. (Progress Reports on Relapsing Fever.)
Weller, B. and Graham, G. M.: Relapsing fever in Central Texas. J. Am. Med. Assoc., **95**: 1834 (1930).

USE OF YOLK SAC OF DEVELOPING CHICK EMBRYO AS MEDIUM FOR GROWING RICKETTSIAE OF ROCKY MOUNTAIN SPOTTED FEVER AND TYPHUS GROUPS*

By HERALD R. COX, *Associate Bacteriologist, Rocky Mountain Laboratory, United States Public Health Service*

The observations herein reported concern the use of the yolk sac tissue (i. e., the embryonic membrane enclosing the yolk mass) of the developing chick embryo for the cultivation of the infectious agents of Rocky Mountain spotted fever (western Montana strain), endemic typhus (Wilmington strain), European or epidemic typhus (Breinl strain), boutonneuse fever (a Moroccan strain), Brazilian spotted fever,[1] and an unidentified rickettsial disease recently isolated from *Amblyomma maculatum* (ticks) collected in Texas (referred to later as *maculatum* infection).[2]

METHOD AND MATERIALS

Fertile eggs that had been incubated at 39° C. for 5 or 6 days were injected in the yolk with infectious material by means of a hypodermic syringe fitted with a 21-gauge needle 1¼ inches long. The inoculum, usually 0.5 cc, was introduced through an opening in the air sac end of the egg just large enough to admit passage of the needle. A greater quantity of material could be introduced through this end of the egg, since the volume of the air sac diminishes to compensate for the material injected. After the hole had been sealed with paraffin, the inoculated egg was incubated at 35° C.

Inoculum.—The original inoculum for the eggs of the spotted fever series was defibrinated guinea pig heart blood taken on the third or fourth day of fever, while the inoculum for the other rickettsiae consisted of the testicular washings of guinea pigs sacrificed on the second day of scrotal involvement. For serial passage of the infectious agents in eggs a 10 percent suspension of yolk sac only, in normal saline, was usually employed. Equally good results were also obtained when a 1:100 or a 1:1000 dilution of the yolk sac was used. The yolk sac was aseptically removed from the infected egg and ground with Alundum

* Contribution from the Division of Infectious Diseases, National Institute of Health, Rocky Mountain Laboratory, Hamilton, Mont.

[1] Obtained recently through the courtesy of Dr. Octavio Malgahaes, Director of the Ezequiel Dias Institute, Minas Geraes, Brazil.

[2] Unpublished work of Dr. R. R. Parker, U. S. Public Health Service.

in a heavy Pyrex 50-cc centrifuge tube fitted with a glass rod (inserted through a gauze stopper) terminating in a ball to make an effective grinding surface.

Tests for infectivity.—In determining the titer of infectivity of any one of the embryonic chick tissues, the following procedure was employed: The tissue selected for titration (yolk sac, chorio-allantois, or embryo proper) was completely removed aseptically from three or four eggs of the same series and washed once or twice with sterile saline to remove any of the yolk or other fluids that might be present. The selected tissue material was then drained free from excess moisture, pooled, weighed, and ground in a mortar with the abrasive to a homogeneous suspension. The ground tissue was diluted with saline to make a 10 percent suspension and the latter was centrifuged (1,500 r. p. m. in an angle centrifuge for 15 minutes) to throw down tissue fragments. The supernatant fluid was carefully pipetted off and diluted decimally with saline, and each dilution was tested by injecting guinea pigs intraperitoneally with 1 cc each. The guinea pigs were carefully observed for scrotal swelling. Daily temperatures were taken until death or discharge (after 28 days), and microscopic examinations for the presence of rickettsiae were made of smears prepared from the peritoneal or scrotal exudates of guinea pigs dying or sacrificed *in extremis*.

RESULTS

Maintenance of strains.—All of the above-mentioned rickettsial infections have been readily maintained in serial passage by the technique previously described.

Of two series of spotted fever transfers (same strain), one has been carried through 10 passages and the other through 37. Endemic typhus has been carried through 37 transfers, European (epidemic typhus) through 10, Brazilian spotted fever through 14, and boutonneuse fever and the recently isolated *maculatum* disease through 35 each.

The spotted fever, endemic typhus, boutonneuse fever, and Brazilian spotted fever strains of rickettsiae usually kill the embryo on the third or fourth day. After the death of the embryo the embryonic tissues and membranes rapidly autolyze. Hence, in order to facilitate the complete removal of the infected yolk sacs it has become routine procedure to transfer the strains on the third or fourth day while the embryo is still living or within 24 hours following death.

Infectivity tests.—Titration tests carried out with the strains of spotted fever and endemic typhus indicated that the yolk sac was more infectious than other tissues of the developing chick. The infective titers of the yolk sac suspensions have been, as a rule, 100 to 1,000 times higher than those usually obtained with other tissues or with blood or tissue suspensions of infected guinea pigs.

Yolk sac suspensions of all of these infectious agents, with the possible exception of the *maculatum* disease, have produced in guinea pigs a shortened incubation period and, as a rule, a more severe type of infection. The spotted fever strains in particular have been so virulent that of over 90 guinea pigs which showed evidence of infection, not one survived.

In table 1 are presented the daily records of guinea pigs injected with tissue suspensions representing the first passage of spotted fever in the developing chick.

TABLE 1.—*Rocky Mountain spotted fever. Records of guinea pigs receiving 1 cc each of chick tissue suspensions on Apr. 18, 1938*

Number of guinea pig	1	2	3	4	5	6
Inoculum	10 percent yolk sac	1 percent yolk sac	10 percent chorio-allantois	1 percent chorio-allantois	10 percent embryo	1 percent embryo
Date, 1938	Temperature, °C					
Apr. 19	39.3	39.0	38.0	38.8	38.8	39.5
20	39.0	40.7	38.2	39.3	39.0	38.8
21	[1] 40.7	[1] 40.3	39.0	39.4	38.8	39.0
22	[1] 40.6	[1] 40.7	40.1	40.8	40.0	40.3
23	[1] 41.0	[2] 39.8	40.9	41.0	[1] 41.0	41.0
24	[2] 40.8	[2] 37.8	[1] 40.8	[1] 40.7	[1] 41.2	40.7
25	[2] 40.6	[3]	[1] 40.6	[2] 40.4	[1] 40.0	40.8
26	[3]		[1] 38.6	[2] 38.8	[1] 39.2	37.0
27			[3]	[3]	[3]	[3]

[1] Scrotal swelling. [2] Scrotal hemorrhage. [3] Dead.

In tables 2 and 3 are recorded the results obtained by injecting guinea pigs with diminishing amounts of centrifuged suspension of fourth and seventeenth passage yolk sac.

TABLE 2.—*Rocky Mountain spotted fever. Titration test of fourth passage yolk sac. (Eggs incubated 4 days at 35° C. Each guinea pig received 1 cc intraperitoneally on May 12, 1938)*

Number of guinea pig	7	8	9	10	11	12
Dilution of yolk sac used as inoculum [1]	10^{-1}	10^{-2}	10^{-3}	10^{-4}	10^{-5}	10^{-6}
Date, 1938	Temperature, °C.					
May 13	40.4	40.0	39.3	39.4	39.2	39.0
14	[2] 41.0	[2] 40.8	39.8	39.6	39.3	39.4
15	[2] 40.4	[2] 40.8	40.8	39.6	39.4	40.0
16	[2] 40.5	[2] 40.8	40.3	[2] 40.4	39.8	39.6
17	[2] 40.8	[2] 40.3	[2] 40.3	[2] 40.8	40.0	40.4
18	[2] 40.5	[2] 40.0	[2] 38.0	[2] 40.8	[2] 40.7	40.6
19	[4]	[2] 39.0	[4]	[2] 40.4	[2] 41.2	40.4
20		[4]		[2] 40.8	[2] 41.0	40.4
21				[2] 40.2	[2] 41.0	40.6
22				[4]	[2] 36.0	37.0
23					[4]	[4]

[1] The 10 dilution was not made. [2] Scrotal swelling. [3] Scrotal hemorrhage. [4] Dead.

Table 3 shows that both the virulence and the infective titer of the spotted fever agent has been readily maintained through at least 17 passages in the yolk sac.

TABLE 3.—*Rocky Mountain spotted fever titration of seventeenth passage yolk sac. (Guinea pigs injected on July 6, 1938. Other data the same as in table 2)*

No. of guinea pig	13	14	15	16	17	18	19
Dilution of yolk sac used as inoculum	10^{-1}	10^{-2}	10^{-3}	10^{-4}	10^{-5}	10^{-6}	10^{-7}
Date, 1938	Temperature, °C.						
July 7	39.3	39.3	39.3	38.5	39.2	38.7	38.2
8	40.7	40.2	39.2	38.5	38.5	38.5	38.0
9	40.5	40.0	38.8	39.0	38.7	38.5	38.2
10	[1] 40.6	[1] 40.3	39.0	40.2	40.3	39.8	38.4
11	[2] 40.4	38.0	40.5	40.2	40.6	41.0	38.4
12	([3])	([3])	40.6	40.6	[1] 40.8	40.8	38.4
13			[1] 40.8	[1] 41.0	[1] 40.3	[1] 40.8	38.6
14			[1] 41.0	[1] 41.0	[1] 40.0	[1] 40.6	39.0
15			[2] 40.5	[1] 40.8	([3])	[1] 40.0	39.0
16			[2] 39.8	[1] 38.6		([3])	[4] 38.4
17			([3])	([3])			

[1] Scrotal swelling.
[2] Scrotal hemorrhage.
[3] Dead.
[4] No evidence of infection. Not immune to a subsequent test with spotted fever virus.

The positive results with yolk sac suspensions of spotted fever in dilutions of 1:1,000,000 represent an infectivity end-point at least 30 times higher than has been reported for mammalian tissues (*1*), 10 times greater than that which we have been able to obtain with cultures of a modified Maitland or Rivers type,[3] and approach the limits of infectivity reported for tick tissue virus (*1*).

Table 4 summarizes some of the results obtained in titration tests with spotted fever and endemic typhus, using various tissues of the developing chick embryo.

The data in table 4 suggest that a higher limit of infectivity is obtained when the inoculated eggs are incubated at 35° C. It is also shown that the yolk (fluid) is infectious, and, in the one experiment made, it contained the infectious agent in even greater quantity than the chorio-allantois or embryo proper. Thus far it has not been determined whether the infectious agent multiplies in the yolk or whether its infectivity is due to extruded rickettsiae from cells of the yolk sac.

In another series of experiments the inoculated eggs were incubated at 32° C., but this temperature was found to be too low for development and survival of the embryo.

A few tests were also made in which embryos younger or older than 5 or 6 days were used. Younger embryos were found to be too readily killed either by the infectious agent or by the lower incubation tem-

[3] Unpublished work.

perature (35° C.) to which they were subsequently subjected, while older embryos (8 or 9 days) gave a lesser yield of rickettsiae.

TABLE 4.—*Rocky Mountain spotted fever and endemic typhus—Comparative titration of tissues of the developing chick*

Disease	Number of transfers in the egg	Temperature of incubation of eggs	Tissue titrated	End-point of titration
Spotted fever, series A	2	39° C.	Yolk sac	1:100,000.
			Chorio-allantois	1:1,000.
			Embryo	1:10,000.
	4	39° C.	Yolk fluid	1:10,000.
			Yolk sac	1:100,000.
			Chorio-allantois	1:1,000.
			Embryo	Less than 1:1,000.
Spotted fever, series B	4	39° C.	Yolk sac	Less than 1:1,000.
			Chorio-allantois	Less than 1:1,000.
			Embryo	Not tested.
	4	35° C.	Yolk sac	1:1,000,000.
			Chorio-allantois	1:1,000.
			Embryo	Not tested.
Spotted fever, series B	17	35° C.	Yolk sac	1:1,000,000.
			Chorio-allantois	Not tested.
			Embryo	Not tested.
	18	35° C.	Yolk sac	1:1,000,000.
			Chorio-allantois	1:10,000.
			Embryo	Less than 1:100.
Endemic typhus	1	35° C.	Yolk sac	1:100,000.
			Chorio-allantois	1:1,000.
			Embryo	1:100.
Endemic typhus	18	35° C.	Yolk sac	1:1,000,000.
			Chorio-allantois	Not tested.
			Embryo	Not tested.

Microscopic observations.—Material to be examined for rickettsiae was spread in a thin layer on slides and stained with Giemsa or by Machiavello's method.[4]

Rickettsiae were rarely or never found in smears from the chorio-allantois or from tissues of the embryo proper. On the other hand, rickettsiae of all the diseases studied, with the exception of European typhus, were readily and consistently found in the yolk sac. In the latter case, rickettsiae have not as yet been observed, although yolk sac suspensions have proved to be typically pathogenic for inoculated guinea pigs.

In smear preparations rickettsiae are rarely or never seen intracellularly, but are found scattered extracellularly throughout the yolk sac tissue. In endemic typhus, spotted fever, and boutonneuse fever, large numbers of clumped rickettsiae are sometimes observed in an apparently extracellular position.

[4] This method, which was devised by Dr. Attilio Machiavello, has been found to be excellent for the demonstration of rickettsiae. It has advantages over Giemsa in that it takes only 7 or 8 minutes to prepare the slide, and the contrast between organisms and cellular material is sharper. The method is as follows: Fix slide in flame. Flood smear with 0.5 percent aqueous basic fuchsin with pH 7.2 to 7.5. Stain for 5 minutes. Rinse rapidly with 0.5 percent citric acid. Wash thoroughly. Counterstain with 1.0 percent aqueous methylene blue for 1 or 2 minutes. Rinse with water and examine when dry.

Rickettsiae were readily found in the first passage of endemic typhus, spotted fever, boutonneuse fever, and the *maculatum* disease, but they were not observed in Brazilian spotted fever until the third passage.[5]

In the *maculatum* disease, it was possible to demonstrate rickettsiae in the yolk sac before they were found in guinea pig tissues (testicular washings and peritoneal exudate). This finding suggests the possibility that the method described may be of value for determining whether or not diseases of unknown etiology are rickettsial.

DISCUSSION

In 1936 Bradford and Titsler (*2*) reported successful cultivation of gonococci in the developing chick embryo. Fertile eggs were injected in the yolk (yolk mass) and serial transfers from egg to egg showed that the organism multiplied in this medium.

More recently Barykine and colleagues (*3*) described a somewhat similar technique in which "exanthematic" (European) typhus was cultivated in the tissues of the developing chick embryo. However, both of the above methods differed from the method described by us in that the *yolk sac* was not employed for passage or demonstration of the infectious agent.

The technique described here is extremely simple and has proved to afford less chance for contamination than do the methods of Maitland (*4*), Rivers (*5, 6*) and Goodpasture (*7*). In the few instances in which bacterial contamination did occur, the bacteria, as a rule, were found in greater numbers in the yolk sac than in the chorio-allantois or other tissues.

In a single preliminary experiment with the virus of equine encephalomyelitis (eastern strain) titration tests showed the infectious agent to have multiplied at least a thousandfold within 30 hours. The yolk sac, chorio-allantois, and embryo proper contained equivalent quantities of the virus.

These observations suggest that the yolk sac may also prove to be a good medium for the isolation and culture of certain bacteria and viruses.

SUMMARY

A technique is described whereby the yolk sac of the developing chick embryo is used for the cultivation of rickettsiae. By this method the rickettsiae of Rocky Mountain spotted fever, endemic typhus, European (epidemic) typhus, boutonneuse fever, Brazilian spotted fever, and an unidentified rickettsial disease recently isolated

[5] The guinea pig that was killed to furnish the inoculum for Brazilian spotted fever had shown only 2 days of fever without any scrotal reaction, and we were unable to demonstrate any rickettsiae in the testicular washings or tunica scrapings.

from *Amblyomma maculatum* (ticks) have been readily maintained in serial passage.

The yolk sac suspensions of spotted fever and endemic typhus have been as a rule 100 to 1,000 times more infective than mammalian tissues or other tissues of the developing chick and approach the limits reported for tick tissues. In addition, in all the diseases studied, with the possible exception of the *maculatum* infection, yolk sac suspensions have produced a more severe infection with a shortened incubation period.

Rickettsiae of all the diseases studied, with the exception of European typhus, were readily and consistently found in the yolk sacs.

It is suggested that the technique, which is very simple and permits a minimum of contamination, may prove of value for the isolation and cultivation of other infectious agents.

REFERENCES

(1) Spencer, R. R., and Parker, R. R.: Variations in the behavior of the virus. *In* Studies on Rocky Mountain Spotted Fever, Hygienic Laboratory Bulletin No. 154, 1930, p. 49.
(2) Bradford, W. L., and Titsler, R.: Experimental gonococcal infection in the chick embryo. Proc. Soc. Exp. Biol. and Med., **34:** 241 (1936).
(3) Barykine, W., in collaboration with Kompaneez, A., Botcharowa, A., and Bauer, H.: Nouvelle methode de culture du virus du typhus exanthématique. Bull. Office International D'Hygiène Publique, **30:** 326 (1938).
(4) Maitland, H. B., and Maitland, M. C.: Cultivation of vaccinia virus without tissue culture. Lancet, **2:** 596 (1928).
(5) Li, C. P., and Rivers, T. M.: Cultivation of vaccine virus. J. Exp. Med., **52:** 465 (1930).
(6) Rivers, T. M.: Cultivation of vaccine virus for Jennerian prophylaxis in man. J. Exp. Med., **54:** 453 (1931).
(7) Woodruff, Alice Miles, and Goodpasture, Ernest W.: The susceptibility of the chorio-allantoic membrane of chick embryos to infection with the fowl-pox virus. Am. J. Path., **7:** 209 (1931).

DEATHS DURING WEEK ENDED DECEMBER 3, 1938

[From the Weekly Health Index, issued by the Bureau of the Census, Department of Commerce]

	Week ended Dec. 3, 1938	Corresponding week, 1937
Data from 88 large cities of the United States:		
Total deaths	8,937	[1] 8,624
Average for 3 prior years	[1] 7,999	
Total deaths, first 48 weeks of year	389,051	413,836
Deaths under 1 year of age	546	[1] 545
Average for 3 prior years	[1] 484	
Deaths under 1 year of age, first 48 weeks of year	25,123	26,554
Data from industrial insurance companies:		
Policies in force	68,314,781	69,983,032
Number of death claims	12,385	13,230
Death claims per 1,000 policies in force, annual rate	9.5	9.9
Death claims per 1,000 policies, first 48 weeks of year, annual rate	9.2	9.7

[1] Data for 86 cities.

PREVALENCE OF DISEASE

No health department, State or local, can effectively prevent or control disease without knowledge of when, where, and under what conditions cases are occurring

UNITED STATES

CURRENT WEEKLY STATE REPORTS

These reports are preliminary, and the figures are subject to change when later returns are received by the State health officers.

In these and the following tables, a zero (0) indicates a positive report and has the same significance as any other figure, while leaders (------) represent no report, with the implication that cases or deaths may have occurred but were not reported to the State health officer.

Cases of certain diseases reported by telegraph by State health officers for the week ended December 10, 1938, rates per 100,000 population (annual basis), and comparison with corresponding week of 1937 and 5-year median

Division and State	Diphtheria				Influenza				Measles			
	Dec. 10, 1938, rate	Dec. 10, 1938, cases	Dec. 11, 1937, cases	1933–37 median	Dec. 10, 1938, rate	Dec. 10, 1938, cases	Dec. 11, 1937, cases	1933–37 median	Dec. 10, 1938, rate	Dec. 10, 1938, cases	Dec. 11, 1937, cases	1933–37 median
NEW ENG.												
Maine	128	21	2	4	6	1	1	1	30	5	42	33
New Hampshire	10	1	0	0	------	------	------	------	10	1	45	9
Vermont	0	0	2	2	------	------	------	------	27	2	144	21
Massachusetts	7	6	2	13	------	------	------	------	226	192	76	117
Rhode Island	0	0	0	0	------	------	------	------	15	2	1	8
Connecticut	6	2	7	5	15	5	5	5	225	75	9	75
MID. ATL.												
New York	14	35	36	47	[1] 10	[1] 14	[1] 13	[1] 13	284	707	93	496
New Jersey	23	19	12	19	10	8	14	20	13	11	581	48
Pennsylvania	27	52	30	70	------	------	------	------	39	76	2,048	249
E. NO. CEN.												
Ohio	53	68	44	77	------	------	23	11	15	20	249	83
Indiana	30	20	33	49	14	9	41	36	21	14	55	31
Illinois	27	41	37	58	5	8	30	22	19	28	754	33
Michigan [2]	23	21	25	25	1	1	1	4	187	173	238	50
Wisconsin	5	3	5	6	36	20	42	40	266	149	68	70
W. NO. CEN.												
Minnesota	35	18	4	6	12	6	2	------	582	296	9	39
Iowa	16	8	3	9	8	4	3	1	166	81	3	3
Missouri	22	17	37	42	27	21	74	58	8	6	913	92
North Dakota	30	4	2	2	103	14	6	6	391	53	1	5
South Dakota	53	7	0	1	15	2	------	------	633	84	------	4
Nebraska	4	1	7	5	------	------	------	------	15	4	1	13
Kansas	42	15	9	16	31	11	10	4	20	7	37	37
SO. ATL.												
Delaware	40	2	1	0	------	------	------	------	------	------	3	3
Maryland [3] [4]	56	18	23	22	40	13	15	14	224	72	14	20
Dist. of Col. [4]	75	9	7	11	33	4	3	2	8	1	6	6
Virginia	121	63	31	57	339	176	------	------	64	33	84	45
West Virginia	87	31	16	35	50	18	12	25	42	15	101	15
North Carolina [5]	108	72	44	74	7	5	7	13	430	288	396	355
South Carolina [5]	31	11	6	14	1,182	425	377	377	11	4	55	24
Georgia [5]	20	12	14	26	167	99	------	------	56	33	------	------
Florida	34	11	23	19	16	5	9	2	41	13	42	3

See footnotes at end of table.

Cases of certain diseases reported by telegraph by State health officers for the week ended December 10, 1938, rates per 100,000 population (annual basis), and comparison with corresponding week of 1937 and 5-year median—Continued

Division and State	Diphtheria				Influenza				Measles			
	Dec. 10, 1938, rate	Dec. 10, 1938, cases	Dec. 11, 1937, cases	1933–37 median	Dec. 10, 1938, rate	Dec. 10, 1938, cases	Dec. 11, 1937, cases	1933–37 median	Dec. 10, 1938, rate	Dec. 10, 1938, cases	Dec. 11, 1937, cases	1933–37 median
E. SO. CEN.												
Kentucky	36	20	17	48	96	54	15	15	12	7	83	6
Tennessee [5]	34	19	27	40	96	53	81	59	22	12	168	23
Alabama [5]	49	27	27	31	223	124	192	95	86	48	17	17
Mississippi [2 5]	31	12	11	15	----	----	----	----	----	----	----	----
W. SO. CEN.												
Arkansas	46	18	15	15	295	116	82	32	46	18	43	2
Louisiana [5]	32	13	28	30	29	12	323	14	64	26	1	8
Oklahoma	53	26	24	24	256	125	44	48	57	28	3	3
Texas [5]	57	67	46	123	280	332	368	197	12	14	64	54
MOUNTAIN												
Montana	19	2	0	3	58	6	----	6	2,293	237	11	5
Idaho	0	0	2	1	85	8	5	1	592	56	13	13
Wyoming	178	8	0	0	----	----	----	----	22	1	1	6
Colorado	78	16	9	9	117	24	----	----	44	9	44	8
New Mexico	49	4	7	4	12	1	----	----	62	5	84	61
Arizona	101	8	2	4	2,177	172	92	27	----	----	----	5
Utah [2]	10	1	0	0	281	28	----	----	231	23	81	20
PACIFIC												
Washington	19	6	3	3	----	----	----	----	780	248	9	75
Oregon	5	1	7	1	117	23	21	21	71	14	12	14
California	51	60	20	42	31	37	52	46	739	872	28	124
Total	36	896	707	1,199	97	1,984	1,963	1,431	167	4,063	6,730	4,615
49 weeks	23	28,035	26,043	35,372	61	60,673	286,700	151,539	657	785,071	276,131	364,496

Division and State	Meningitis, meningococcus				Poliomyelitis				Scarlet fever			
	Dec. 10, 1938, rate	Dec. 10, 1938, cases	Dec. 11, 1937, cases	1933–37 median	Dec. 10, 1938, rate	Dec. 10, 1938, cases	Dec. 11, 1937, cases	1933–37 median	Dec. 10, 1938, rate	Dec. 10, 1938, cases	Dec. 11, 1937, cases	1933–37 median
NEW ENG.												
Maine	0	0	0	0	0	0	0	0	67	11	36	13
New Hampshire	0	0	0	0	0	0	0	0	102	10	24	6
Vermont	0	0	0	0	0	0	0	0	54	4	15	14
Massachusetts	2.4	2	2	2	0	0	0	0	102	87	174	174
Rhode Island	0	0	0	0	0	0	0	0	31	4	23	20
Connecticut	0	0	2	0	0	0	0	0	132	44	64	44
MID. ATL.												
New York	0.8	2	5	8	0.8	2	2	3	41	103	405	466
New Jersey	0	0	1	2	1.2	1	0	1	95	79	103	110
Pennsylvania	1.5	3	5	5	0	0	2	3	133	260	421	459
E. NO. CEN.												
Ohio	0.8	1	6	3	0.8	1	2	2	262	338	379	429
Indiana	0	0	0	2	0	0	1	0	215	143	181	190
Illinois	0.7	1	1	7	0.7	1	2	1	214	324	557	512
Michigan [2]	4	4	1	2	0	0	1	1	531	492	416	335
Wisconsin	1.8	1	0	1	0	0	2	1	276	155	200	200

See footnotes at end of table.

Cases of certain diseases reported by telegraph by State health officers for the week ended December 10, 1938, rates per 100,000 population (annual basis), and comparison with corresponding week of 1937 and 5-year median—Continued

Division and State	Meningitis, meningococcus				Poliomyelitis				Scarlet fever			
	Dec. 10, 1938, rate	Dec. 10, 1938, cases	Dec. 11, 1937, cases	1933–37 median	Dec. 10, 1938, rate	Dec. 10, 1938, cases	Dec. 11, 1937, cases	1933–37 median	Dec. 10, 1938, rate	Dec. 10, 1938, cases	Dec. 11 1937, cases	1933–37 median
W. NO. CEN.												
Minnesota	0	0	1	1	0	0	4	0	206	105	168	140
Iowa	0	0	0	1	0	0	1	1	119	58	184	100
Missouri	1.3	1	1	1	1.3	1	2	1	159	122	273	139
North Dakota	7	1	0	0	7	1	0	0	192	26	20	43
South Dakota	0	0	0	0	0	0	0	0	249	33	18	30
Nebraska	0	0	1	1	0	0	0	0	99	26	27	42
Kansas	0	0	1	2	0	0	0	0	428	153	151	151
SO. ATL.												
Delaware	0	0	0	0	0	0	0	0	240	12	5	10
Maryland [2] [3]	0	0	2	2	0	0	0	0	158	51	68	88
Dist. of Col. [4]	0	0	0	0	0	0	0	0	58	7	12	17
Virginia	1.9	1	5	5	1.9	1	1	1	89	46	55	61
West Virginia	6	2	6	3	0	0	0	0	137	49	92	101
North Carolina [3]	0	0	4	2	1.5	1	0	2	131	88	59	87
South Carolina [3]	0	0	3	0	0	0	0	1	31	11	4	6
Georgia [3]	0	0	1	0	3	2	2	0	32	19	24	24
Florida	0	0	0	0	0	0	0	0	66	21	6	6
E. SO. CEN.												
Kentucky	5	3	0	3	0	0	1	1	159	89	68	68
Tennessee [3]	4	2	1	1	1.8	1	2	2	58	32	45	74
Alabama [3]	4	2	11	2	5	3	0	0	59	33	18	30
Mississippi [2] [3]	0	0	0	0	0	0	3	0	34	13	12	29
W. SO. CEN.												
Arkansas	0	0	0	0	0	0	1	0	48	19	28	14
Louisiana [3]	2.4	1	1	0	0	0	0	2	56	23	8	17
Oklahoma	0	0	1	1	2	1	1	1	115	56	54	36
Texas [3]	2.5	3	6	6	0	0	7	4	95	113	100	100
MOUNTAIN												
Montana	0	0	0	0	0	0	0	0	155	16	30	30
Idaho	21	2	0	0	0	0	0	0	254	24	33	33
Wyoming	0	0	0	0	0	0	0	0	67	3	12	16
Colorado	5	1	0	1	0	0	0	0	239	49	27	27
New Mexico	0	0	0	0	12	1	1	0	259	21	16	32
Arizona	0	0	1	1	0	0	0	0	51	4	5	12
Utah [3]	0	0	1	0	0	0	1	0	281	28	51	88
PACIFIC												
Washington	0	0	1	1	3	1	1	1	226	72	67	67
Oregon	0	0	0	0	10	2	0	0	259	51	54	54
California	0.8	1	2	3	3	4	3	7	181	214	230	228
Total	1.4	34	73	73	1	24	43	56	151	3,741	5,022	5,181
49 weeks	2.2	2,700	5,146	5,146	1.4	1,657	9,359	7,147	144	175,202	209,505	209,505

See footnotes at end of table.

Cases of certain diseases reported by telegraph by State health officers for the week ended December 10, 1938, rates per 100,000 population (annual basis), and comparison with corresponding week of 1937 and 5-year median—Continued

Division and State	Smallpox				Typhoid and paratyphoid fever				Whooping cough		
	Dec. 10, 1938, rate	Dec. 10, 1938, cases	Dec. 11, 1937, cases	1933–37 median	Dec. 10, 1938, rate	Dec. 10, 1938, cases	Dec. 11, 1937, cases	1933–37 median	Dec. 10, 1938, rate	Dec. 10, 1938, cases	Dec. 11, 1937, cases
NEW ENG.											
Maine	0	0	0	0	12	2	2	2	481	79	55
New Hampshire	0	0	0	0	0	0	0	0	20	2	2
Vermont	0	0	0	0	0	0	0	0	830	61	18
Massachusetts	0	0	0	0	0	0	6	2	209	177	217
Rhode Island	0	0	0	0	8	1	0	0	337	44	15
Connecticut	0	0	0	0	0	0	0	1	317	106	78
MID. ATL.											
New York	0	0	0	0	2	6	7	9	279	694	398
New Jersey	0	0	0	0	1	1	3	3	461	384	133
Pennsylvania	0	0	0	0	3	5	19	19	215	419	323
E. NO. CEN.											
Ohio	2	2	2	0	0	0	1	4	108	140	155
Indiana	62	41	41	3	2	1	5	2	30	20	18
Illinois	0	0	14	2	5	7	0	13	394	595	87
Michigan [1]	5	5	0	0	9	8	0	5	358	332	175
Wisconsin	20	11	2	7	5	3	0	1	866	486	163
W. NO. CEN.											
Minnesota	31	16	30	4	0	0	0	1	75	38	45
Iowa	27	13	46	10	14	7	0	3	25	12	31
Missouri	14	11	12	2	7	5	10	10	35	27	41
North Dakota	0	0	22	1	7	1	0	0	59	8	12
South Dakota	83	11	0	3	0	0	0	0	15	2	31
Nebraska	11	3	0	2	4	1	1	1	42	11	5
Kansas	0	0	5	5	0	0	0	1	56	20	77
SO. ATL.											
Delaware	0	0	0	0	20	1	0	1	260	13	14
Maryland [2] [3]	0	0	0	0	16	5	3	4	149	48	48
Dist. of Col. [4]	0	0	0	0	0	0	2	2	166	20	4
Virginia	0	0	0	0	8	4	2	9	77	40	107
West Virginia	0	0	0	0	14	5	1	6	62	22	77
North Carolina [5]	0	0	0	0	1	1	4	6	339	227	246
South Carolina [5]	0	0	0	0	6	2	0	1	131	47	41
Georgia [5]	2	1	1	0	5	3	3	8	24	14	11
Florida	0	0	3	0	25	8	2	0	66	21	1
E. SO. CEN.											
Kentucky	0	0	0	0	5	3	1	11	66	37	58
Tennessee [5]	0	0	2	2	2	1	3	11	22	12	34
Alabama [5]	0	0	0	0	7	4	2	2	83	46	19
Mississippi [2] [5]	0	0	0	0	0	0	0	7	----	----	----
W. SO. CEN.											
Arkansas	5	2	2	1	13	5	2	2	48	19	15
Louisiana [5]	0	0	0	0	10	4	8	12	22	9	7
Oklahoma	39	19	3	2	12	6	9	9	27	13	22
Texas [5]	4	5	2	2	22	26	24	24	28	33	131
MOUNTAIN											
Montana	39	4	28	25	0	0	3	2	358	37	24
Idaho	169	16	23	0	21	2	1	1	0	0	13
Wyoming	0	0	9	2	44	2	0	0	22	1	8
Colorado	112	23	22	7	15	3	2	0	102	21	9
New Mexico	0	0	0	0	37	3	7	9	383	31	29
Arizona	63	5	2	0	0	0	0	1	51	4	----
Utah [1]	0	0	1	0	0	0	0	0	161	16	12
PACIFIC											
Washington	9	3	39	30	3	1	0	2	82	26	86
Oregon	25	5	13	3	5	1	2	2	117	23	42
California	3	3	2	4	4	5	9	10	84	99	387
Total	8	199	326	118	6	143	144	280	186	4,536	3,514
49 weeks	11	13,885	10,097	6,941	11	13,862	14,699	16,964	167	190,511	----

[1] New York City only.
[2] Period ended earlier than Saturday.
[3] Rocky Mountain spotted fever, week ended December 10, 1938, Maryland, 1 case.
[4] Psittacosis, week ended December 10, 1938, District of Columbia, 3 cases (including delayed report of 2 cases for the week ended Dec. 3).
[5] Typhus fever, week ended December 10, 1938, 54 cases as follows: North Carolina, 2; South Carolina, 4; Georgia, 18; Tennessee, 2; Alabama, 8; Mississippi, 1; Louisiana, 1; Texas, 18.

SUMMARY OF MONTHLY REPORTS FROM STATES

The following summary of cases reported monthly by States is published weekly and covers only those States from which reports are received during the current week.

State	Meningitis, meningococcus	Diphtheria	Influenza	Malaria	Measles	Pellagra	Poliomyelitis	Scarlet fever	Smallpox	Typhoid and paratyphoid fever
October 1938										
Alaska	0	8	70				0		0	0
November 1938										
District of Columbia	0	40	6		6		1	44	0	5
Indiana	4	98	39		37		0	495	44	14
Kentucky	11	135	117	7	38	3	2	388	19	47
Maine	1	28	12		108		3	35	0	5
Missouri	5	95	41	4	35	1	5	403	61	12
New Mexico	0	24	5		26	1	0	63	2	23
Rhode Island	1	2			5		0	41	0	6
Vermont	0	1			5		1	35	0	1
West Virginia	8	67	43		57		1	322	0	22

October 1938

	Cases
Alaska:	
Chickenpox	4
Mumps	1
Whooping cough	33

November 1938

	Cases
Actinomycosis:	
Rhode Island	1
Chickenpox:	
District of Columbia	36
Indiana	275
Kentucky	306
Maine	262
Missouri	150
New Mexico	46
Rhode Island	60
Vermont	354
West Virginia	340
Conjunctivitis:	
New Mexico	1
Diarrhea:	
New Mexico	11
Dysentery:	
Kentucky (bacillary)	8
Missouri (amoebic)	2
New Mexico (amoebic)	7
New Mexico (bacillary)	17
New Mexico (unspecified)	11
Rhode Island	3
Encephalitis, epidemic or lethargic:	
Missouri	1
Food poisoning:	
New Mexico	1

November 1938—Continued

	Cases
German measles:	
Kentucky	1
Maine	14
New Mexico	2
Rhode Island	1
Vermont	5
Impetigo contagiosa:	
Rhode Island	2
Vermont	17
Mumps:	
Indiana	104
Kentucky	57
Maine	13
Missouri	53
New Mexico	7
Rhode Island	106
Vermont	61
West Virginia	19
Ophthalmia neonatorum:	
New Mexico	1
Rhode Island	1
Puerperal septicemia:	
New Mexico	2
Psittacosis:	
District of Columbia	3
Rabies in animals:	
Indiana	27
Missouri	4
Rhode Island	3
Scabies:	
Rhode Island	2
Septic sore throat:	
Kentucky	26
Maine	4
Missouri	63
New Mexico	7

November 1938—Continued

	Cases
Septic sore throat—Contd.	
Rhode Island	16
Vermont	3
Tetanus:	
Missouri	1
New Mexico	1
Trachoma:	
Kentucky	3
Missouri	21
Tularaemia:	
Indiana	8
Kentucky	3
Missouri	10
Undulant fever:	
Indiana	8
Kentucky	2
Maine	1
Missouri	3
New Mexico	3
Rhode Island	1
Vermont	4
West Virginia	1
Vincent's infection:	
Maine	6
Vermont	7
Whooping cough:	
District of Columbia	54
Indiana	48
Kentucky	55
Maine	159
Missouri	66
New Mexico	80
Rhode Island	159
Vermont	287
West Virginia	135

WEEKLY REPORTS FROM CITIES

City reports for week ended December 3, 1938

This table summarizes the reports received weekly from a selected list of 140 cities for the purpose of showing a cross section of the current urban incidence of the communicable diseases listed in the table.

State and city	Diphtheria cases	Influenza		Measles cases	Pneumonia deaths	Scarlet fever cases	Smallpox cases	Tuberculosis deaths	Typhoid fever cases	Whooping cough cases	Deaths, all causes
		Cases	Deaths								
Data for 90 cities:											
5-year average	268	201	52	919	648	1,301	11	352	35	1,041	----
Current week [1]	155	119	43	884	540	1,013	18	353	17	1,649	----
Maine:											
Portland	0	----	0	1	2	0	0	1	0	8	23
New Hampshire:											
Concord	0	----	0	0	0	0	0	0	0	0	6
Nashua	0	----	0	0	0	0	0	0	0	0	6
Vermont:											
Barre	0	----	0	0	0	1	0	0	0	0	2
Burlington	0	----	0	0	0	0	0	0	0	3	12
Rutland	0	----	0	0	0	0	0	0	0	0	3
Massachusetts:											
Boston	1	----	1	16	19	31	0	11	0	32	213
Fall River	0	----	0	0	3	3	0	5	0	2	29
Springfield	0	----	0	19	2	2	0	0	0	9	41
Worcester	1	----	0	1	8	6	0	2	0	17	53
Rhode Island:											
Pawtucket	0	----	0	0	0	3	0	0	1	0	18
Providence	0	1	0	0	7	3	0	1	1	30	76
Connecticut:											
Bridgeport	0	1	1	0	1	2	0	3	0	8	24
Hartford	0	----	0	0	2	4	0	0	0	9	45
New Haven	2	1	0	3	4	2	0	0	0	14	34
New York:											
Buffalo	0	----	0	28	13	19	0	9	0	32	150
New York	19	11	4	58	66	55	0	72	5	204	1,513
Rochester	0	----	0	6	3	3	0	1	0	9	59
Syracuse	0	----	0	1	4	3	0	1	0	35	36
New Jersey:											
Camden	0	----	0	0	3	0	0	2	0	0	34
Newark	1	1	1	2	6	12	0	10	0	33	94
Trenton	0	1	0	0	1	2	0	0	0	9	32
Pennsylvania:											
Philadelphia	1	2	1	9	14	32	0	20	1	102	485
Pittsburgh	3	2	1	4	12	19	0	4	0	17	179
Reading	0	----	1	0	1	0	0	0	0	1	32
Scranton	0	----	----	0	----	3	0	----	0	13	----
Ohio:											
Cincinnati	15	----	1	0	7	15	0	9	0	7	151
Cleveland	3	6	0	1	20	28	0	7	1	55	203
Columbus	2	----	0	0	4	7	0	2	0	10	128
Toledo	0	----	0	1	2	24	0	5	0	11	70
Indiana:											
Anderson	0	----	0	0	1	5	0	0	1	1	9
Fort Wayne	0	----	0	1	0	2	0	1	2	0	24
Indianapolis	2	----	0	2	16	29	17	2	0	0	109
Terre Haute	1	----	0	1	0	1	0	0	0	0	9
Illinois:											
Alton	1	----	0	0	0	1	0	0	0	1	10
Chicago	13	9	4	17	40	134	0	46	2	422	752
Elgin	0	----	0	0	1	3	0	0	0	1	7
Moline	0	----	0	0	1	0	0	0	0	2	15
Springfield	1	----	0	0	3	5	0	0	0	2	26
Michigan:											
Detroit	7	1	2	8	13	81	0	11	0	167	226
Flint	0	----	0	26	10	40	0	0	0	6	32
Grand Rapids	0	----	0	1	2	24	0	0	0	4	32
Wisconsin:											
Kenosha	0	----	0	0	1	2	0	0	0	13	11
Madison	0	----	0	2	0	1	0	0	0	4	6
Milwaukee	2	2	2	2	7	41	0	6	0	156	97
Racine	0	----	0	0	1	0	0	0	0	7	12
Superior	0	----	0	0	2	0	0	0	0	0	11
Minnesota:											
Duluth	0	----	0	0	4	0	0	2	0	2	29
Minneapolis	1	----	0	72	11	19	0	1	0	1	133
St. Paul	0	1	1	78	6	10	0	0	0	6	66

[1] Figures for South Bend, Ind., estimated, report not received.

City reports for week ended December 3, 1938—Continued

State and city	Diphtheria cases	Influenza		Measles cases	Pneumonia deaths	Scarlet fever cases	Smallpox cases	Tuberculosis deaths	Typhoid fever cases	Whooping cough cases	Deaths, all causes
		Cases	Deaths								
Iowa:											
Cedar Rapids	0			1		0	0		6	2	
Davenport	0			0		3	0		0	0	
Des Moines	0		0	0	0	18	0	0	0	0	37
Sioux City	0			57		4	0		0	0	
Waterloo	3			1		4	0		0	0	
Missouri:											
Kansas City	1		2	1	15	26	1	7	0	3	123
St. Joseph	0		0	0	1	3	0	1	0	0	24
St. Louis	9		1	1	6	26	0	12	1	12	184
North Dakota:											
Fargo	0		0	140	0	5	0	0	0	0	3
Grand Forks	1			1		0	0		0	0	
Minot	0		0	28	0	1	0	0	0	0	3
South Dakota:											
Aberdeen	2			0		0	0		0	0	
Nebraska:											
Lincoln	1			0		5	0		0	0	
Omaha	0		0	1	2	7	0	1	0	0	71
Kansas:							0				
Lawrence	0		0	1	0	0	0	0	0	0	7
Topeka	0	1	1	0	2	3	0	0	0	8	17
Wichita	1		0	0	5	5	0	0	0	0	27
Delaware:											
Wilmington	3		0	1	1	7	0	0	0	2	22
Maryland:											
Baltimore	1	6	1	57	19	6	0	6	0	14	244
Cumberland	0		0	0	1	0	0	0	0	0	10
Frederick	1		0	0	1	1	0	0	0	0	5
Dist. of Col.:											
Washington	2	2	2	2	4	14	0	9	0	20	155
Virginia:											
Lynchburg	2		0	0	3	1	0	0	0	9	17
Norfolk	1		0	3	2	6	0	2	1	1	24
Richmond	0		2	1	2	1	0	1	0	0	40
Roanoke	0		0	0	2	0	0	0	0	0	21
West Virginia:											
Charleston	3	1	0	1	2	2	0	1	1	0	18
Huntington	0			0		0	0		0	0	
Wheeling	0		0	0	1	1	0	1	0	4	23
North Carolina:											
Gastonia	0			0		0	0		1	0	
Raleigh	0		0	0	1	1	0	0	0	1	5
Wilmington	4		0	0	1	1	0	1	0	3	18
Winston-Salem	0		0	10	2	6	0	1	0	0	21
South Carolina:											
Charleston	2	18	0	1	2	0	0	2	0	0	21
Florence	0		0	0	1	0	0	0	0	0	12
Greenville	1		0	0	0	0	0	0	0	0	7
Georgia:											
Atlanta	1	9	1	1	6	6	0	0	0	0	
Brunswick	0	1	1	0	0	0	0	0	0	0	3
Savannah	0	19	0	0	4	0	0	0	0	4	30
Florida:											
Miami	0		0	0	1	0	0	2	0	0	40
Tampa	1	1	1	9	1	1	0	1	0	2	27
Kentucky:											
Ashland	0		0	0	0	1	0	0	0	0	10
Covington	2	2	0	0	3	5	0	0	0	0	21
Lexington	0		0	0	1	0	0	0	0	0	21
Louisville	1		1	3	9	14	0	2	0	5	58
Tennessee:											
Knoxville	3	5	0	1	1	0	0	1	0	1	30
Memphis	1	3	2	2	5	11	0	3	0	8	85
Nashville	0		0	0	3	3	0	1	0	4	55
Alabama:											
Birmingham	2	2	0	0	3	6	0	11	0	0	94
Mobile	3		0	0	3	2	0	1	0	0	29
Montgomery	0			1		0	0		0	1	
Arkansas:											
Fort Smith	1	6		0		0	1		0	0	
Little Rock	1		0	0	2	2	0	1	0	0	4

City reports for week ended December 3, 1938—Continued

State and city	Diphtheria cases	Influenza		Measles cases	Pneumonia deaths	Scarlet fever cases	Smallpox cases	Tuberculosis deaths	Typhoid fever cases	Whooping cough cases	Deaths, all causes
		Cases	Deaths								
Louisiana:											
Lake Charles	0	------	0	0	0	1	0	0	0	0	5
New Orleans	15	3	3	2	22	9	0	11	0	14	212
Shreveport	0	------	0	0	10	2	0	1	0	0	52
Oklahoma:											
Oklahoma City	1	3	0	1	5	5	0	1	0	0	50
Texas:											
Dallas	5	1	1	0	3	6	0	1	0	0	69
Fort Worth	2	------	0	1	4	12	0	1	2	0	56
Galveston	0	------	0	0	1	0	0	1	1	0	24
Houston	9	------	0	1	8	4	0	5	1	1	108
San Antonio	1	1	3	2	9	3	0	10	0	0	77
Montana:											
Billings	0	------	0	1	0	3	0	1	0	2	8
Great Falls	0	------	0	2	1	4	0	0	0	0	11
Helena	0	------	0	1	0	0	0	0	0	0	5
Missoula	0	1	0	0	1	1	0	0	0	0	9
Idaho:											
Boise	0	------	0	0	1	0	0	0	0	0	14
Colorado:											
Colorado Springs	0	------	0	0	1	1	0	0	0	0	8
Denver	7	------	2	4	7	4	0	6	1	32	96
Pueblo	0	------	0	0	2	7	0	0	0	4	10
New Mexico:											
Albuquerque	0	------	0	0	2	1	0	4	0	0	13
Utah:											
Salt Lake City	0	------	0	1	2	9	0	0	0	0	29
Washington:											
Seattle	0	------	0	1	12	11	0	4	0	16	112
Spokane	0	------	0	3	4	2	0	0	0	0	30
Tacoma	0	------	0	0	1	4	0	2	0	14	28
Oregon:											
Portland	0	------	0	0	2	6	0	2	0	0	77
Salem	0	------	------	1	------	3	0	------	0	0	------
California:											
Los Angeles	4	8	0	6	26	48	0	13	0	32	404
Sacramento	0	------	0	2	5	83	0	0	0	1	37
San Francisco	1	3	0	273	6	26	0	8	0	10	159

State and city	Meningitis, meningococcus		Poliomyelitis cases	State and city	Meningitis, meningococcus		Poliomyelitis cases
	Cases	Deaths			Cases	Deaths	
New Hampshire:				Missouri:			
Nashua	1	0	0	Kansas City	0	1	0
Massachusetts:				District of Columbia:			
Worcester	0	1	0	Washington	0	0	1
New York:				South Carolina:			
Buffalo	1	1	0	Charleston	0	0	1
New York	3	2	1	Alabama:			
Pennsylvania:				Birmingham	3	1	0
Philadelphia	0	0	1	Texas:			
Ohio:				Houston	2	0	0
Columbus	2	2	0	Colorado:			
Michigan:				Denver	1	0	0
Flint	1	1	0				
Minnesota:							
St. Paul	1	0	0				

Encephalitis, epidemic or lethargic.—Cases: Topeka, 1; Washington, 1; Louisville, 1; Spokane, 1.
Pellagra.—Cases: Toledo, 1; Atlanta, 2; Savannah, 2; Mobile, 1; New Orleans, 2.
Typhus fever.—Cases: New York, 1; Charleston, S. C., 1; Savannah, 2; San Antonio, 1; Los Angeles, 3.

FOREIGN AND INSULAR

CUBA

Habana—Communicable diseases—4 weeks ended November 19, 1938.—During the 4 weeks ended November 19, 1938, certain communicable diseases were reported in Habana, Cuba, as follows:

Disease	Cases	Deaths	Disease	Cases	Deaths
Diphtheria	11		Tuberculosis	9	2
Malaria	18	1	Typhoid fever	11	2
Scarlet fever	1				

Provinces—Notifiable diseases—4 weeks ended November 12, 1938.—During the 4 weeks ended November 12, 1938, cases of certain notifiable diseases were reported in the Provinces of Cuba as follows:

Disease	Pinar del Rio	Habana	Matanzas	Santa Clara	Camaguey	Oriente	Total
Beriberi						3	3
Cancer	1	1		5		3	10
Chickenpox				2			2
Diphtheria	1	16	3	1	3		24
Hookworm disease		1				2	3
Leprosy		3	2	3		2	10
Malaria	19	18	11	74	25	49	196
Measles			1	3			4
Trachoma				1			1
Tuberculosis	23	114	26	63	10	22	258
Typhoid fever	24	45	12	38	15	53	187
Yaws				6		7	13

ITALY

Communicable diseases—4 weeks ended September 11, 1938.—During the 4 weeks ended September 11, 1938, cases of certain communicable diseases were reported in Italy as follows:

Disease	Aug. 15-21	Aug. 22-28	Aug. 29-Sept. 4	Sept. 5-11
Anthrax	40	40	42	53
Cerebrospinal meningitis	9	11	9	10
Chickenpox	48	51	44	35
Diphtheria	336	421	436	451
Dysentery	74	69	82	73
Hookworm disease	41	45	43	21
Lethargic encephalitis		1	1	
Measles	600	445	527	267
Mumps	92	68	67	78
Paratyphoid fever	238	302	301	282
Pellagra	4	7	1	
Poliomyelitis	53	65	42	68
Puerperal fever	24	30	35	24
Scarlet fever	129	190	203	208
Typhoid fever	1,765	1,950	1,999	1,651
Undulant fever	69	86	55	51
Whooping cough	312	263	256	241

JAMAICA

Communicable diseases—4 weeks ended November 26, 1938.—During the 4 weeks ended November 26, 1938, cases of certain communicable diseases were reported in Kingston, Jamaica, and in the island outside of Kingston, as follows:

Disease	Kingston	Other localities	Disease	Kingston	Other localities
Chickenpox	2	1	Leprosy		7
Diphtheria	1	1	Puerperal septicemia		3
Dysentery	4	6	Tuberculosis	48	70
Erysipelas		1	Typhoid fever	4	54

PANAMA CANAL ZONE

Notifiable diseases—July–September 1938.—During the months of July, August, and September 1938, certain notifiable diseases, including imported cases, were reported in the Panama Canal Zone and terminal cities as follows:

Disease	July		August		September	
	Cases	Deaths	Cases	Deaths	Cases	Deaths
Chickenpox	10		9		16	
Diphtheria	19	1	15		8	
Dysentery (amoebic)	11	3	12	3	6	4
Dysentery (bacillary)	9		4		5	3
Leprosy			2		5	
Malaria	101	6	86	1	69	2
Measles	17		2		9	
Meningococcus meningitis	2	1			1	1
Mumps	2		2		6	
Paratyphoid fever			1		1	
Pneumonia		22		25		40
Scarlet fever	1		1			
Tuberculosis		24		28		26
Typhoid fever	6		4	1	1	
Whooping cough	[1] 5					

[1] In the Canal Zone only.

CHOLERA, PLAGUE, SMALLPOX, TYPHUS FEVER, AND YELLOW FEVER

NOTE.—A table giving current information of the world prevalence of quarantinable diseases appeared in the PUBLIC HEALTH REPORTS for November 25, 1938, pages 2107–2119. A similar cumulative table will appear in future issues of the PUBLIC HEALTH REPORTS for the last Friday of each month.

Cholera

Afghanistan—Kabul.—For the week ended November 12, 1938, 18 cases of cholera were reported in Kabul, Afghanistan.

China—Hong Kong.—For the week ended December 3, 1938, 2 cases of cholera were reported in Hong Kong, China.

Plague

Belgian Congo—Rekwa.—For the week ended December 3, 1938, 1 case of plague was reported in Rekwa, Belgian Congo.

Hawaii Territory—Island of Hawaii—Hamakua District.—Rats proved positive for plague have been found in Hamakua District, Island of Hawaii, Hawaii Territory, as follows: Hamakua Mill Sector—November 25, 1938, 3 rats; Paauhau Sector—November 25, 2 rats, November 29, 1 rat.

Peru—Lima Department.—During the month of October 1938, 6 cases of plague with 3 deaths were reported in Lima Department, Peru.

Tunisia—Tunis.—For the week ended December 10, 1938, 2 cases of plague were reported in Tunis, Tunisia.

Smallpox

Colombia.—During the month of September 1938, smallpox has been reported in Colombia as follows: Antioquia Department, 5 cases; Caldas Department, 16 cases, 1 death; Cundinamarca Department—Bogota, 24 cases, 1 death; Magdalena Department, 11 cases; Valle Department, 3 cases; Intendencia of Meta—Villavicencio, 1 case, 1 death.

Yellow Fever

French Equatorial Africa—Sosso.—On November 7, 1938, 1 case of yellow fever was reported in Sosso, French Equatorial Africa.

Sudan (French).—Yellow fever has been reported in French Sudan as follows: December 1, 1938, 3 cases in Kona; December 6, 1938, 1 case in Sangha.

X